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Ocean conservation : a baseline study of knowledge and attitudes of fifth graders

Susan Alexa Giles
San Jose State University

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OCEAN CONSERVATION: A BASELINE STUDY OF KNOWLEDGE AND ATTITUDES OF FIFTH GRADERS

A Thesis

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by Susan Alexa Giles

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APPROVED FOR THE DEPARTMENT OF ENVIRONMENTAL STUDIES

Dr. Gary A. Klee, Professor of Environmental Studies
Committee Chairperson

Dr. David Asquith, Associate Professor of Sociology

Mr. Jeffery S. Bryant, Monterey Bay Aquarium

APPROVED FOR THE UNIVERSITY

ABSTRACT

OCEAN CONSERVATION: A BASELINE STUDY OF KNOWLEDGE AND ATTITUDES OF FIFTH GRADERS

by Susan Alexa Giles

This study provides baseline information on the current ocean conservation knowledge and attitudes of fifth graders in three locations: central coastal California, inland California, and Denver, Colorado and investigates what ocean-related experiences contribute to higher knowledge and positive attitudes.

A survey on ocean conservation concepts was developed for this study and completed by 418 fifth graders from nineteen schools.

There was no significant difference in Knowledge and Attitude scores among the three locations. Females scored higher on Knowledge and Attitude, and private schools scored higher than public schools on Knowledge.

This research finds that although fifth graders do not have a high level of knowledge about ocean conservation, they have positive attitudes, and a willingness to participate in activities to protect oceans. None of the experiences contributing to higher Knowledge and Attitude scores require coastal access.

This research supports the need for ocean conservation education on a national basis.

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I thank my parents for the motivation to further my education and their continued encouragement that I should follow my dreams.

And finally, I need to thank all the teachers and fifth graders who participated in this project. I was amazed at the commitment and devotion these teachers have towards teaching children. They opened my eyes to a new respect for the teaching profession, and I believe they are the true heroes in this country. I hope this study helps to encourage all children to fall in love with the ocean the way I have, and inspires them to protect the oceans for the future.

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CHAPTER 1

INTRODUCTION

Background

Historically, the ocean has been a source of great mystery, perpetuated by the belief that the world's seas are bottomless and boundless (Ray 1964). Despite greater efforts in recent years to increase public knowledge of the problems concerning our ocean resources, there is still a widespread lack of understanding of how humans alter ocean systems and how this personally affects our lives (Menduno 1998; NOAA 1998).

Unfortunately, ocean conservation has lagged far behind terrestrial conservation (Agardy 1994; McIntyre 1992). For example, President Clinton's Forest Plan budgeted $68.1 million for 1998, while the 1997 budget for the entire U.S. National Marine Sanctuary program was only $12 million. Nevertheless, research has shown that humans are harming the ocean environment at an increasing rate through overfishing, pollution, and destruction of habitat (Botsford, Castilla, and Peterson 1997; Dayton, et al. 1995; Goldberg 1997; Hagler 1995; Klee 1999; Nixon 1998; Safina 1995 and 1998).

Ocean conservation issues revolve around the human interactions which limit the ocean's ability to regulate global climate, provide food and other resources, protect coastal habitats, preserve national security, and provide recreation (Mack 1993; NOAA 1998; Norse 1993; Webster & Curry 1998). In an effort to start resolving the conflicts of human pressures on the ocean, it is important to look at what people know and how they feel about ocean conservation (Earle 1995).

Importance

The Environmental Education Act of 1970 finally brought learning about the environment and how to conserve our natural resources formally into the public school systems. This Act has proven quite beneficial, as research has shown that children are capable of acquiring knowledge and developing attitudes about the environment as early as kindergarten (Bryant & Hungerford 1979). It is vital to teach children the great value of a healthy environment so that they will ultimately be able to make wise decisions about our national and global environment.

Currently, there are no national standards for an Environmental Education curriculum in grades K-12. Rather, environmental education is intertwined with national Science standards, with environmental programs receiving only sporadic attention. Consequently, there has been much criticism of the direction of environmental education. In the past, environmental education has aimed at increasing knowledge only. Meanwhile, research shows this approach has not been shown to correlate with positive behavior changes towards the environment (Gifford, Hay, and Boros 1982; Hungerford & Volk 1990). Nevertheless, the development of non-formal environmental education over the last 25 years has produced numerous assessments of environmental knowledge and attitudes, most surveying a broad range of environmental issues. Whereas most studies seek to evaluate a particular project, they can be biased if researchers are looking for positive affirmation of their program's effectiveness (Huberty & Klein 1996).

Few studies have focused specifically on evaluating knowledge and attitudes about ocean systems (Brody & Koch 1989), and rarely have these included ocean

conservation issues (Fortner & Teates 1980; Fortner & Meyer 1991). Furthermore, there are no assessments on the current level of children's knowledge and attitudes about ocean conservation. Therefore, baseline studies are a necessary foundation in developing relevant educational material on ocean conservation.

Ocean Conservation

Before assessing ocean conservation knowledge and attitudes, we must first examine the difference between ocean science and ocean conservation. Whereas *ocean science* is more factual and knowledge based (Fox 1995), *ocean conservation* fosters understanding and commitment to protecting natural resources. Although ocean conservation is rooted in science, it is broader based, including economics, politics, and cultural heritage (McIntyre 1992; Norse 1995). Ocean conservation education aims to help people discover their connection with the natural systems, and fosters stewardship for the ocean ecosystems rather than strictly acquiring knowledge about them.

Ocean education (incorporating *ocean science* and *ocean conservation*), has been defined as, "that part of the total educational process which enables people to develop a sensitivity to and a general understanding of the role of the seas and fresh water in human affairs and the impact of society on the marine and aquatic environments" (Fortner & Mayer 1989 p.135). The National Marine Educator's Association has facilitated ocean education by bringing together ocean educators and introducing educational material into public schools. Through their publication, Current: The Journal of Marine Education, they keep educators informed about new educational tools and programs, as well as

professional development opportunities. However, most ocean programs still take place within the coastal states. Federal programs like the National Sea Grant Program, the National Science Foundation, and the National Oceanographic and Atmospheric Administration (NOAA) have provided and encouraged ocean education, particularly along the coastline (Fortner & Mayer 1989).

Children need to be educated so they will be able to comprehend environmental issues affecting their lives, and understand the consequences of their actions (Brown & Roughgarden 1990). Currently, most adults receive environmental information entirely from the media. However, journalists tend to highlight and sensationalize events such as the Exxon Valdez oil spill, blaming problems on big corporations rather than portraying environmental problems in a scientific framework (Niebuhr 1998; Ozawa 1996; SeaWeb 1996). The goal of education of ocean conservation issues should not be training future oceanographers and marine biologists, though it may inspire students to go into ocean related careers. Rather, the purpose of ocean conservation education for children is for them to become educated adults about the ocean environment.

By the year 2025, nearly 75 percent of the U.S. population will live in coastal areas (NOAA 1998). Therefore, it is important to ensure that everyone is educated in the basic knowledge of ocean conservation concepts and issues.

Problem Statement

What is the best method of educating and inspiring children to become stewards of the oceans? It is important to examine ocean-related activities outside of the

classroom, as practical experiences are often the best educational tool for appreciation of the environment (George & Kaplan 1998; Korpan et al. 1997; Milliman 1996). Research suggests that first-hand experiences are the biggest factor in increased knowledge and attitudes about environmental issues (Fazio & Zanna 1981; Regan & Fazio 1977). Yet, in the past, the influence of television has also been a successful medium for communicating environmental information (Fortner & Lyon 1985). Advanced technology is now changing the way information is received, with cable television, videos, and the Internet rapidly increasing the amount and speed of information available to the public. Furthermore, aquariums are experiencing an increasing audience from the new facilities that have opened recently in several major cities, with several more due to open in the near future. What sources of information are successful in communicating important conservation messages, and ultimately in changing personal behaviors?

The purpose of this study was to evaluate the current level of knowledge and attitudes about ocean conservation held by fifth graders in three locations: central coastal California, inland California, and Denver, Colorado. This research investigated if proximity to the coast influences levels of knowledge and attitudes, and examined what ocean-related activities correlate with higher Knowledge and Attitude scores.

Role of the Monterey Bay Aquarium

Since opening in 1984, the Monterey Bay Aquarium (MBA) has become a world renowned institution and model for many other aquariums. Though it excels in all areas, a primary emphasis has been on education. In particular, MBA has become a leader in

children's ocean education. Over 85,000 school children visit the aquarium every year. In addition, MBA reaches a broader audience through off-site educational programs, teacher training, publications, and their web site.

Recently, the Board of Trustees changed the mission statement of the Monterey Bay Aquarium to reflect a stronger commitment to ocean conservation. The Board firmly believes that children are the key to the ocean's future as they are tomorrow's stewards, and that, currently, children are undereducated in ocean conservation issues. As a result, the Trustees have directed a large portion of their budget to develop educational material with conservation themes.

In 1997, MBA instigated the Future of the Ocean Initiative (FOTO). One product of FOTO will be a series of twelve ocean conservation activity books for fifth graders. On a national level, science curricula frequently focus on the ocean in the fifth grade. The FOTO books are based on the different oceanic systems, including Terrestrial Aquatic Systems, Coastal Ocean Systems, and Offshore Ocean Systems. Colwell (1997) argues that, in the past, environmental education has been ineffective, based on the two separate concepts of nature and culture. He reasons that if instead, environmental education was based on systems, it would be more effective by not contradicting the ecological vision of a unified world. The FOTO books, organized by systems, not habitats, are grounded in the concept of ocean conservation by connecting humans to the ocean environments.

Working with local teachers, the MBA's educational staff began field testing two illustrated books in early 1998. Although they are currently evaluating the effectiveness

of the books, they did not conduct formal baseline studies of current ocean conservation knowledge and attitudes levels of fifth graders before producing FOTO. The aim of this research project was to supplement and strengthen the Monterey Bay Aquarium's evaluation of some of the products of FOTO by completing a preliminary stage in the evaluation process.

Research Questions

This research focused on an analysis of what concepts fifth grade students hold about ocean conservation, and if they have a foundation to become good ocean stewards. The investigation addressed the following six research questions:

1. What is the current level of ocean conservation knowledge of fifth graders in the study areas?

2. Do fifth graders in the study areas have positive attitudes and a willingness to participate in actions that protect the ocean?

3. Does proximity to the coast influence Knowledge and/or Attitude scores on the ocean conservation survey?

4. Do fifth graders who have higher Knowledge scores also have more positive Attitude scores on the ocean conservation survey?

5. Does the gender, or type of school attended affect Knowledge and/or Attitude scores on the ocean conservation survey?

6. What experiences and sources of information are related to fifth graders higher Knowledge and/or positive Attitude scores on the ocean conservation survey?

Implications

Although the Monterey Bay Aquarium's primary focus for FOTO is schools in California, their ultimate goal is to reach a national audience. This study focused on fifth graders in California, with a comparison to students in Denver, Colorado, to examine if FOTO may be a useful and effective educational tool on a widespread audience.

Data collected from this study provides baseline data for the Monterey Bay Aquarium to use in a possible longitudinal study on changes in fifth grade knowledge and attitudes about ocean conservation. The results from this study will be helpful in further development of educational material on ocean conservation issues by establishing an instrument for assessing ocean conservation knowledge and attitudes of fifth graders nationwide.

CHAPTER 2

LITERATURE REVIEW

The realm of ocean conservation ranges from techniques for preserving and restoring a healthy ocean environment to public awareness and education on the need to conserve the ocean's resources. There is a lack of available data on a global scale of research and evaluations of ocean-based educational programs and curricula. This void creates a great need for an ocean conservation journal that consolidates and addresses the education of this important environmental issue.

Environmental Education Goals

The goals and guidelines of environmental education are rooted in two documents, the Belgrade Charter (1976) and the Tbilisi Declaration (1978) which together contribute to a common understanding of effective environmental education (NAAEE 1996, p.1). The Belgrade Charter, in particular, provides a widely accepted mission for environmental education:

> The goal of environmental education is to develop a world population that is aware of and concerned about, the environment and its associated problems, and which has the knowledge, skills, attitudes, motivations, and commitment to work individually and collectively towards solutions of current problems and prevention of new ones (UNESCO-UNEP 1976, p.1).

The North American Association for Environmental Education (NAAEE) defines the knowledge of environmental issues as "based on factual accuracy, and which provides an understanding of environmental concepts, conditions, and issues" (NAAEE

1996, p.5). Environmental attitudes are defined as, "a set of values and feelings of concern for the environment and the motivation for actively participating in environmental improvement and protection" (Hungerford & Volk 1990, p.9). The guidelines of NAAEE emphasize that environmental education should highlight building skills to promote responsible actions that address environmental concerns (NAAEE 1996, p. 9).

This thesis documents the current level of knowledge of ocean conservation in the selected study areas and whether misconceptions about the oceans exist. This information can then be used as a guideline for developing education materials about ocean conservation that lead to environmental education goals. This study, to examine what activities would be optimal to promote ocean stewardship, documents ocean-related activities of fifth graders and what type of ocean conservation actions they are willing to participate.

Environmental Education Assessments and Evaluations

There are three basic classifications of evaluations for environmental educational programs. The first type of classification, a Baseline Evaluation, is used to indicate current levels of information about a population. The second classification, a Formative Evaluation, is an evaluation such as a pilot test designed to improve a product during product development. The third classification, a Summative Evaluation, is an evaluation of product effectiveness, for instance, a pre- and post-test of an environmental program (Joint Committee on Standards for Educational Evaluations 1981). This research

addresses the first type of evaluation, a Baseline Evaluation. However, it is important to look at the myriad of evaluations that have occurred for environmental programs.

Although there have been few ocean-specific educational programs for grades K-12, there have been numerous and diverse environmental curricula developed for children in the last 25 years. Many evaluations and assessments of the knowledge of broad environmental issues have occurred (Brody & Koch 1989; Hausbech, Milbrath, and Enright 1992; Papageorgiou et al. 1996). Evaluation of the impact of an educational program is also a common research method assessing environmental material (Aird & Tomera 1977; Armstrong and Impara 1991; Birch & Schwaab 1983; Fortner & Lyon 1985; Ryan 1991). Overall, these types of studies tend to be biased to produce favorable outcomes of each program (Huberty & Klein 1996).

Lemming et al. (1993) critically reviewed the outcome of 34 environmental education studies published since 1974 that attempted to demonstrate changes in environmentally relevant knowledge, attitudes, or behaviors. They found that most assessments measured changes in attitudes, knowledge, or both; however, few measured changes in behavior. Since the long-term goal for environmental education is to encourage positive behaviors towards preserving environmental quality, they found this trend unproductive in evaluating environmental curriculum. While this is quite valid, they failed to look into the need for baseline studies of current levels of attitudes and knowledge of a specific environmental topic as a foundation to developing educational material. Actually, few baseline studies of knowledge and attitudes exist as a basis for further educational material development in environmental education (Fortner & Teates

1980; Roth & Perez 1992). Additionally, rather than relying on long-term studies of individual behavior changes, research should be focusing on determining what factors, or activities encourage actions towards more positive conservation behaviors such as participating in a beach clean-up, making ocean-friendly consumer choices, or supporting conservation campaigns.

A common and serious error that Lemming et al. (1993) uncovered in many evaluations of education programs was the unit of analysis that most researchers use. Most studies tested existing groups of subjects, that is, an entire class of students. However, differences within teachers (teachers' diverse backgrounds and interests), different types of student interactions in a class (small vs. large classes), and different school characteristics (socioeconomic factors) must be considered. Therefore, individual students in a class do not represent independent measures. Yet, most experiments ignored this problem and classified each student in the classrooms as independent, which results in a greatly increased probability of a Type I error (rejection of a true null hypothesis).

Developing Environmental Behaviors

Many environmental educators are now supporting the importance of developing students who demonstrate positive behaviors towards the environment. Hines, Hungerford, and Tomera (1986) found that environmental curriculum has not been leading towards this goal. They examined 128 studies in a meta-analysis, and devised a model of predictors of responsible environmental behaviors from fifteen variables.

Variables found to be associated with responsible environmental behaviors included: knowledge of issues, knowledge of action strategies, locus of control (an individual's perception of whether or not they have the ability to bring about change from their behavior), attitudes, verbal commitment, and an individual's sense of responsibility. However, they also admit that predicting behavior is a very complex process. What is most convincing, is that they found a critical component to environmental action is whether an individual has the skill to appropriately apply knowledge to a given problem.

Hungerford and Volk (1990) built on this analysis to propose a new model of changing learner behavior through environmental education. They argue that traditional environmental education does not work because it emphasizes increased knowledge leading to changed behaviors. Their research into environmental behavior does not verify this linear model. Awareness of issues does not necessarily lead to positive behaviors towards the environment. Therefore, teachers must change the focus of information to give students a reason the environment affects them personally. Children must be given the sense of "ownership" so they can develop stewardship towards the environment – the ultimate goal of environmental education. For example, children could help in a wetland restoration project and then take responsibility for monitoring the site for progress. There has been little research into the effectiveness of this method and no longitudinal studies looking at changed behaviors.

Most environmental information that is portrayed through the media incorporates the "doom and gloom" approach (Weilbacher 1994). This can frighten children into thinking they are powerless and that it is too late for them to do anything to help the

environment. Environmental education should instead strive to teach children ways that they can make a difference in helping to maintain a healthy planet. Research should address what factors encourage children to act more positively towards conservation, and on what experiences contribute to children feeling they are making a difference to help maintain healthy oceans (Thompson & Barton 1994).

Ocean Education Studies

There have been few studies specifically focusing on the environmental issues of the oceans and related water concerns. With increased public awareness of the problems of overfishing, loss of wetlands, and coastal pollution, the need for ocean education has not been totally ignored (Chase 1990; Fortner & Mayer 1989; Goodwin 1978; Jacobius 1977; Le Doux-Bloom 1995). Yet little research exists on the knowledge and attitudes of children concerning ocean topics, particularly ocean conservation. Perhaps this is a reflection of a shortage of ocean conservation curricula and informed teachers. Dresser & Butzow (1981) found that in Maine an ocean infusion program would more likely be explored in elementary schools that had a higher percentage of teachers who had more academic preparation in science and mathematics. They also found a greater likelihood of ocean education in schools within 50 miles of the ocean environment. With a rapidly increasing population moving to this nation's coasts, it is imperative that all students are introduced to ocean conservation issues.

Increasing teachers' knowledge base is an important component when evaluating curriculum. Beiswenger, Sturges, and Jones (1992) found a correlation between how

much teachers perceived they knew about water conservation topics and how often they integrated this topic in their curriculum with elementary students. Future efforts to introduce ocean conservation curriculum, or any environmental programs into classrooms, needs to integrate teacher education and evaluation as a fundamental part of the program for any effectiveness to occur (Gustaitis & McGrath 1992).

Brody & Koch (1989) combine science and the environment to address the knowledge and attitudes of fourth, eighth, and eleventh grade students in ocean topics. By using ocean science concepts in relation to real-life events and issues, the assessment reaches a broader conceptual framework of social and natural science rather than the testing of isolated incidents. They found not only low scores on knowledge across age groups but broad misconceptions on basic concepts such as the ocean being a limitless resource. The basis of the survey was to assess if students had the kind of knowledge needed to become responsible citizens who make intelligent decisions regarding the ocean resources. They concluded that the critical first step in curriculum development process should be to determine the relevant concepts and principles that students already know. Then, knowledge based on this material can be directed at more complex concepts in ways that directly relate to students' existing relevant knowledge. The only limitation with this approach is that it stresses only the science knowledge aspect of learning about the oceans. While ocean conservation decisions do need to be based on sound science, science should not be the sole motivating factor for children to appreciate a healthy environment (Lucas 1980; Morrell 1998).

Rosanne Fortner is one of the leading researchers focusing on knowledge and

attitude assessments regarding ocean topics. She completed one of the only longitudinal studies on this subject, starting with a baseline study in ocean education of tenth graders in Virginia (Fortner & Teates 1980). At that time, there had been only one survey specific to ocean and aquatic awareness of any significance (Howe & Price 1976). Fortner designed the Survey of Oceanic Attitudes and Knowledge (SOAK) to indicate the current level of knowledge and attitudes of tenth graders in Virginia and to identify experiences related to the ocean in which students had participated. The study also examined the relationship between ocean knowledge and attitudes. Although overall knowledge was low, 93 percent expressed positive attitudes toward ocean issues. However, most attitude questions were directed at feelings, beliefs and opinions, with none committing to personal behaviors. Still, though most students scored low on knowledge questions, personal ocean-related experiences seemed to contribute the most to overall awareness of the ocean environment.

Fortner then continued the study with fifth and ninth graders' knowledge and attitudes toward the oceans and Great Lakes in 1983, and 1987 (Fortner & Mayer 1991). The study did not track individual students, rather used comparison groups. The most significant difference found between responses in 1979, 1983, and 1987 was source of the information. In 1979, students listed movies and television as their greatest influence, while the category of school was selected first in 1983 and 1987. This is most likely a result of the Ohio Sea Grant Education Program supporting a curriculum for fifth and ninth graders entitled *Oceanic Education Activities for Great Lakes Schools* (OEAGLS) in 1983 (Fortner & Mayer 1983). Fortner and Mayer (1991) found attitudes about Lake

Erie became more negative over the years, though attitudes about oceans in general remained positive. The researchers reasoned that the information students received was now more concentrated in the classroom, and at the time the information about Lake Erie was mostly negative concerning problems associated with human impacts.

Fortner has made a great contribution to the assessment of knowledge and attitudes in ocean topics among children. This present study goes beyond her work in three ways. The focus here is ocean conservation not ocean science. The geographical base is broader. And finally, this study adds a measurement of personal commitment to positive environmental actions that protect the oceans. The latter measure is important because in order to design effective ocean conservation education, it is necessary to first establish what children know and how they feel about the personal actions that can protect the oceans.

Standardized Environmental Instruments

Most instruments for environmental evaluations are created specifically for a particular study (Lemming et al. 1993). Recently, two widely accepted instruments have emerged to evaluate children's knowledge and attitudes on a broad range of environmental issues. There is a strong need for this type of instrument to allow comparisons among educational programs and populations, and to evaluate progress.

The *Children's Attitudes Toward the Environment Scale* (CATES) was developed as a general measure of environmental attitudes of children 8 to 12 years of age (Musser & Malkus 1994). Questions are based on the idea that attitudes have three components:

beliefs, affect, and behavioral intentions (from Fishbein & Ajzen 1975). Each item of the CATES scales describes two types of children. For example, "Some kids think dams on rivers are bad because they hurt plants and animals, but other kids think dams on rivers are good because they prevent floods." Children are then asked to choose which group of kids describes them, and if the statement is "really true," or "somewhat true." By using psychometric principles (a conceptual model into which one can fit a set of test exercises and apply statistical theory), one score is achieved for simple comparisons of different programs (Thorndike 1982).

The *Children's Environmental Attitude and Knowledge Scale* (CHEAKES) was designed to measure ecological attitudes and knowledge of Grades 1-7 (Lemming, Dwyer, and Bracken 1995). One problem with being designed for such a large age range is the difficulty of the knowledge section for the younger children. The authors acknowledge this fact. However, they feel it is worthwhile to identify young children who score exceptionally high. It might be more worthwhile to devise two versions of the knowledge section so as to identify what level of understanding of environmental concepts exists at an earlier age.

The ecology scale was based on an adult scale developed by Maloney and Braucht (1975) to combine attitudinal components of commitment (verbal and actual), behavior, and affect. Items cover this range and vary from, "To save water, I would be willing to use less water when I bathe," to "I turn off the water in the sink while I brush my teeth to conserve water," to "I am not worried about running out of water." The instrument consists of two sub-scales, Attitude and Knowledge, and the CHEAKES Total

Scale. The total score is derived from a combination score obtained from the attitude and knowledge scales, with a higher score indicating combined positive attitudes and increased knowledge.

Environmental education covers a broad range of complex issues. Both of these instruments were developed using rigorous standards, and both are useful to researchers to use for a variety of purposes. Focusing solely on ocean conservation issues, the instrument developed for this study will be able to monitor progress in the knowledge and attitudes of fifth graders and examine positive changes in actions taken toward the ocean environment if used over time.

Evaluating Children's Art

Zimmerman (1994) argues that, in the past, children's progress and achievements in art have been ignored in national standardized tests. He reasons that it would be difficult to develop a national, standardized test that was culturally sensitive in the assessment of children's artwork. However, he argues that it would be worthwhile to develop some type of evaluation that accounts for different social backgrounds rather than ignore art altogether. He suggests that art assessments from a socio-anthropological point of view could be used to examine students' cultural values and beliefs. Although little research of this type has been attempted, it would be an exciting method of comparing children's values and beliefs about the ocean.

Research has shown a strong connection between children's art and their environment (Allison 1980; Brown 1994; Raloff 1998; Rubenstein 1987). Social factors

influence the way children observe their world, and recreate it in artwork (Brown 1994). Therefore, to evaluate environmental knowledge and attitudes through artwork, researchers could compare awareness and visual recall among subjects (Lark – Horovitz, Lewis, and Luca 1967). Brown (1994) compared the artwork of children from two cultures, Thailand and Australia, and found significant differences in subject matter, media, and art style.

Though this thesis does not attempt to thoroughly evaluate artwork produced by the ocean conservation survey to determine fifth graders' knowledge and attitudes about ocean conservation, this area of research might be of significant use to educators and communicators.

Summary

The research presented in this thesis builds on the work presented here, with some important differences. First, no other study has been solely based on ocean conservation. This study focused on what knowledge and attitudes fifth graders have toward ocean conservation to better understand ways to communicate to this age group. Second, by developing an instrument for knowledge and attitudes on broad ocean conservation issues, researchers will be able to make comparisons of programs and activities among a wide geographic range of children. This may enable educators to more effectively educate different audiences about ocean conservation. Furthermore, this study makes progress into understanding an important aspect of environmental education – personal commitment, by examining effective ways to create responsible stewards of the ocean.

CHAPTER 3

METHODS

Introduction

Data for this research were collected during November and December 1998 from a survey developed in the course of this study (see Appendix A for the survey used in this study). The data from this survey were analyzed to answer the following six research questions:

1. What is the current level of ocean conservation knowledge of fifth graders in the study areas?

2. Do fifth graders in the study areas have positive attitudes and a willingness to participate in actions that protect the ocean?

3. Does proximity to the coast influence Knowledge and/or Attitude scores on the ocean conservation survey?

4. Do fifth graders who have higher Knowledge scores also have more positive Attitude scores on the ocean conservation survey?

5. Does the gender, or type of school attended affect Knowledge and/or Attitude scores on the ocean conservation survey?

6. What experiences and sources of information are related to students' higher Knowledge and/or positive Attitude scores on the ocean conservation survey?

Additional information for this study was gathered through a teacher questionnaire (see Appendix A). A completed teacher questionnaire was required from each teacher to document what type of ocean information was taught in each classroom.

Population

The population for this study consisted of students in fifth grade classrooms along the central coast of California, in one inland California City (Fresno), and in Denver, Colorado. The research population included all fifth grade classrooms in schools that were public or private within the study area. The population of fifth grade classrooms included some mixed-grade classes. For consistent baseline data, only students and teachers not exposed to FOTO were considered for this study. The Monterey Bay Aquarium (MBA) provided a list of all the teachers who had worked on the creation of FOTO to eliminate those teachers from the recruitment list.

Recruitment of teachers in California was non-random from a list of all teachers who visited MBA with their students from October 1997 to May 1998. Only those who were listed as fifth grade teachers from the two California study areas were sent a recruitment letter. A copy of the recruitment letter can be found in Appendix A.

In June 1999, a $93 million aquarium, the Colorado Ocean Journey (COJ), is scheduled to open in Denver, Colorado. The education staff of COJ assisted with the recruitment of teachers in Denver, Colorado and all teachers who participated as part of the Colorado study area were known to the staff of COJ. This study creates an exciting platform for a long-term study in Denver of changes in ocean conservation awareness resulting from an aquarium in a landlocked city.

Students were permitted to complete the survey if they wanted to participate in this research and if their parents had signed a consent form. A copy of the consent form and of the Human Subjects Review Board approval letter are included in Appendix B.

Study Areas

The central California coast was defined as all locations south of San Jose and north of Carmel Highlands, within 30 miles of the coast. The central California coast was chosen as part of this study because it was one of the prime coastal destinations in America, it was adjacent to the largest national marine sanctuary in the country, and has a local aquarium.

Fresno, California was chosen as the inland California location because it is a fairly large city (population, 406,000) that is closer to the mountains of Yosemite National Park (90 miles) than to the coast (200 miles). Fresno is not considered a coastal city, as day trips to the coastline are not easily accomplished. Rather, Fresno County is known as one of the leading agricultural areas in California. Although Fresno does have a local zoo, it does not have a local aquarium.

Denver, Colorado was chosen as the third location for this study for several reasons. Though not geographically the exact center of the country, it is landlocked and 1000 road miles from the nearest ocean. Denver is also a large city, with a population of 500,000 and a metropolitan area of 2 million people. In addition, though presently there is no local aquarium, in June 1999 a $93 million aquarium, the Colorado Ocean Journey, is scheduled to open in Denver.

Design

The survey in this study consisted of thirty-one fixed-alternative questions, appropriately suited to the level of fifth graders. In addition, there were three open-ended

questions. Though personal interviews might have led to a more comprehensive picture of the knowledge and attitudes of fifth graders, this technique is not suitable for an instrument that can be administered easily, economically, and consistently. The survey developed for this study was designed to facilitate further research and evaluations of fifth grade classrooms regarding ocean conservation. Therefore, it was necessary to keep the instrument as simple as possible. Additionally, the fixed-alternative type instrument creates an opportunity to discover what misconceptions occur in the population regarding the oceans. Knowledge of misconceptions may suggest ways to focus communication about protecting ocean ecosystems.

Instrumentation and Data Collection

Teachers who agreed to participate in the study answered a questionnaire on their teaching credentials, teaching curricula, and on what they thought fifth grade students know about ocean conservation issues (see Appendix A for the teacher questionnaire). The purpose of questioning the teachers was twofold. First, the information from the teachers was used to verify that the survey response of the students was accurate, lending credibility to data received from the student survey. Teachers provided further clarification of what students should be aware of by reporting what topics were covered and what field trips they participated in with their classrooms. Second, teachers are more apt to utilize the research from this study if they are involved in the survey process.

During the initial development of the survey, the investigator met with thirty-one teachers, all involved in a two-year intensive, science-based ocean educational program

with the Monterey Bay Aquarium education department. The draft survey instrument was distributed to the teachers, and later they gave feedback and critiqued the instrument. Many of the teacher suggestions were incorporated in the final instrument. Further critique by several ocean educators and ocean conservationists helped to establish content validity of the instrument and to refine the survey before pilot testing. Suggestions from teachers and educators included:

- Simplifying vocabulary.
- Making survey more "fun" and less like a test.
- Reducing the number of answer choices per question.
- Adding a few open-ended questions.
- Rewording of questions to make reading comprehension easier.

All data for this study were collected during November and December 1998 from fifth grade classrooms during normal school hours, with teachers present.

Analysis

The data from the ocean conservation survey were analyzed to determine the current level of knowledge that fifth graders have about ocean conservation and to determine if they have positive attitudes toward actions that protect the ocean. The unit of analysis for this study was the classroom (Lemming et al. 1993). Quantitative statistical analysis was then applied to the data. The statistical significance level for this study was established at 0.05 (α= 0.05).

Answers from completed surveys were transferred onto Scantron sheets to generate the raw data in a computer file. The data were then compiled into an SPSS file. Statistical tests used included t-tests, ANOVA, Pearson's correlation (measurement of linear relationship), multiple regression, chi-square frequency tables, and factor analysis.

Knowledge section. The first section of the survey involved knowledge of ocean conservation issues and concepts (questions 3-12). These ten questions have a right answer, with each correct response credited five points for a Knowledge score ranging between zero and fifty.

Attitude section. The second section of the survey (questions 13-18) involved a range of answers from unconcerned to more positive attitudes and willingness to participate in protecting the ocean. Positive attitudes and actions resulted in a higher Attitude score. "Correct" responses to the six attitude questions range from one to three, resulting in an Attitude score range from six to eighteen.

Experience section. The third section of the survey (questions 19-31) addressed how much ocean-related experience fifth graders had and was used to determine what sources of information are associated with students' knowledge and attitudes about ocean conservation.

Open-ended questions. The fourth section of the survey (questions 32-34) consisted of three open-ended questions to further enhance information on the knowledge and attitudes of fifth graders. Limited qualitative analyses were extracted from the responses.

Pilot Study

A pilot study of the survey instrument was conducted in September and October 1998. The sample for the pilot study was recruited from teachers involved with the Monterey Bay Aquarium teacher workshop in July 1998. Five fifth grade classrooms (n=5), consisting of 141 students, completed the ocean conservation survey for the pilot study.

Although all classrooms involved in the pilot study were located in coastal California, some of the samples of the pilot study were located beyond the geographic area defined for this study. Table 1 shows that all of the classes, with the exception of Pilot Study Group 3, had high exposure to ocean-related activities.

Table 1. Pilot Study: Frequency of Ocean-Related Experiences by Group. A chi square frequency table showed Pilot Study Group 3 had significantly fewer ocean-related experiences.

	Pilot Study Group1	Pilot Study Group 2	Pilot Study Group 3	Pilot Study Group 4	Pilot Study Group 5
Experience					
Vist to an aquarium > 5 times	69%	65%	7%	66%	40%
Visit to the ocean > 10 times	90%	76%	18%	86%	49%

There were several reasons for using these classrooms for a pilot test of the ocean conservation survey. First, the teachers had been involved in the development of the instrument and were highly motivated to participate in the pilot study. Second, it was necessary to determine construct validity - that the instrument measured what it was meant to measure. By testing fifth graders with high exposure to ocean related activities, relatively high scores were expected.

Table 2 shows that schools reporting more exposure to ocean activities did score higher, with Pilot Study Group 3 scoring the lowest on Knowledge and Attitudes. As Table 3 indicates, an ANOVA generated on Knowledge scores with the effect of location showed significantly lower scores for Pilot Study Group 3 and Pilot Study Group 5. One possible reason Pilot Study Group 5 scored low on Knowledge was because

Table 2: Pilot Study: Results of Knowledge and Attitude Scores by Group.

Location of school	Type of school	n	Knowledge Score (mean/ SD)	Percent Correct	Attitude Score (mean/ SD)	Percent Positive
Pilot Group 1	Public	29	37.24/ 9.02	75%	15.72/ 2.46	87%
Pilot Group 2	Public	17	37.94/ 6.63	76%	15.71/ 1.40	87%
Pilot Group 3	Public	28	26.54/ 10.35	53%	13.86/ 2.53	77%
Pilot Group 4	Private	32	38.59/ 6.83	77%	16.00/ 1.57	89%
Pilot Group 5	Private	35	30.43/ 9.02	61%	14.80/ 3.22	82%
Total		**141**				

of difficulties in the use of the Scantron answer sheets. In Group 5 only, answer "bubbles" on the sheet were "numbered" whereas the survey answers were listed as "letters." This caused some confusion for the students in marking answers and possibly caused lower scores.

Another purpose of the pilot study was to obtain reaction from the fifth graders about the survey. This was accomplished by the investigator verbally questioning the students after they completed the survey about what questions they found difficult or confusing. The pilot study was productively used to refine the sampling technique, testing whether to administer the survey orally or written, the feasibility of using Scantron sheets for ease of data analysis, and for estimating time for administration of the survey.

Table 3: Pilot Study: Results of an ANOVA Showing Effect of Group on Scores. A Bonferroni pairwise comparison showed Pilot Study Group 3 and 5 scored significantly lower than the other 3 Groups for Knowledge; Pilot Study Group 3 scored significantly lower in Attitude than the other 4 Groups.

Source of Variation	Sums of Squares	DF	Mean Squares	F	Significance of F
Group					
Knowledge	3245.70	4	811.43	10.87	0.000*
Attitude	88.86	4	22.21	3.77	0.006*

* $p < 0.05$ (any result below 0.05 is a statistical level of sigificance)

CHAPTER 4

RESULTS

Response Rates – Teachers

Coastal California. Twenty-four recruitment letters were sent to teachers in the coastal California study area during October 1998. There was a response from twelve teachers, a fifty percent response rate. One teacher was no longer teaching fifth grade, and another teacher was currently teaching emotionally disturbed students and thought the students would give unreliable answers to the survey. Therefore, ten classrooms participated in the coastal California area, resulting in 192 returned surveys for the coastal California portion of the sample.

Inland California. Fourteen recruitment letters were sent to teachers in the Fresno study area during October 1998. There was a response from six teachers, a forty-three percent response rate. One teacher's response arrived after the survey dates of November 16-17, 1998. Two of the teachers who responded from inland California were from the same school. Therefore, five classrooms from four schools participated in the inland California area, resulting in ninety-five returned surveys for the inland California portion of the sample.

Denver, Colorado. Six teachers were recruited in the Denver area with the help of the education department of Colorado Ocean Journey. One teacher's classroom was in Eagle County, 100 miles west of Denver, and was included in this study. Therefore, six classrooms from the Denver area participated in the survey, resulting in 146 returned surveys for this portion of the sample.

Response Rates - Students

A total of twenty-one, fifth grade classrooms (n= 21) participated in the student ocean conservation survey, resulting in 433 returned surveys. Six surveys were discarded due to at least one page not answered. In addition, two special education classrooms from the coastal California portion were dropped due to the small number of students in those classrooms. It should be noted that the scores from the two special education classes' answers were in the same range as the other schools; however, the small number of students in those classes could have skewed the statistical tests applied to the data. Therefore, the results of this study are composed of data from nineteen schools (n=19), and 418 completed surveys. The location of schools, number of students from each class, and funding type (public or private) of the schools are listed in Table 4.

Two hundred and five (205) respondents were female, and two hundred and ten (210) were male. Three (3) respondents did not indicate their gender. Thirty-one (31) respondents were nine years old, 286 were ten years old, 98 were eleven years old, and one respondent was twelve years old. Two (2) respondents did not indicate their age. All schools were located in middle to upper-middle class areas. The average time for a class to complete the survey was 28.7 minutes, with the minimum time at 20 minutes and the maximum time at 34 minutes.

Teacher Information

The nineteen teachers who consented to their classes participating in the ocean conservation survey had an average of seventeen teaching years. One teacher was

Table 4: Locations of Classrooms and Types of School Funding.

Location of school	n	Type of school Funding
Coastal California	**180 Total**	
Coastal CA 1	15	Public
Coastal CA 2	18	Public
Coastal CA 3	28	Public
Coastal CA 4	22	Public
Coastal CA 5	15	Private (religious)
Coastal CA 6	24	Private (Montessori)
Coastal CA 7	32	Public
Coastal CA 8	26	Public
Inland California	**93 Total**	
Inland CA 1	26	Public
Inland CA 2	17	Private (religious)
Inland CA 3	20	Private (religious)
Inland CA 4	19	Private (religious)
Inland CA 5	11	Private
Denver, Colorado	**145 Total**	
Denver 1	25	Public
Denver 2	20	Public
Denver 3	31	Public (Charter)
Denver 4	24	Public
Denver 5	22	Public (Charter)
Denver 6	23	Public
Total	**418**	

currently in the first year of teaching, and eleven teachers had over fifteen years teaching experience. Fifteen of the nineteen teachers had taught ocean ecosystems to fifth grade classes, though not necessarily to their current fifth grade class. Some examples of environmental education and conservation values the teachers reported they covered in their oceans education program included: pollution and oil spill education, overfishing, composting, habitats, man's negative impact on the environment, and the use of natural resources. Some examples of educational materials the teachers reported they used in their classrooms included: materials from the Monterey Bay Aquarium; Sanctuary Science, a week long classroom curriculum from Long Marine Lab (which is located in Santa Cruz, CA); For Sea (developed by Marine Science Center in Poulsha, WA); and Voyage of the Mimi, an interdisciplinary, multimedia approach that uses videos, software, and print materials.

Coastal California field trip activities. Seven out of eight teachers reported they lead field trips to the ocean with students, four of eight teachers lead student field trips to a wetland area, and all eight teachers lead students on field trips to aquariums.

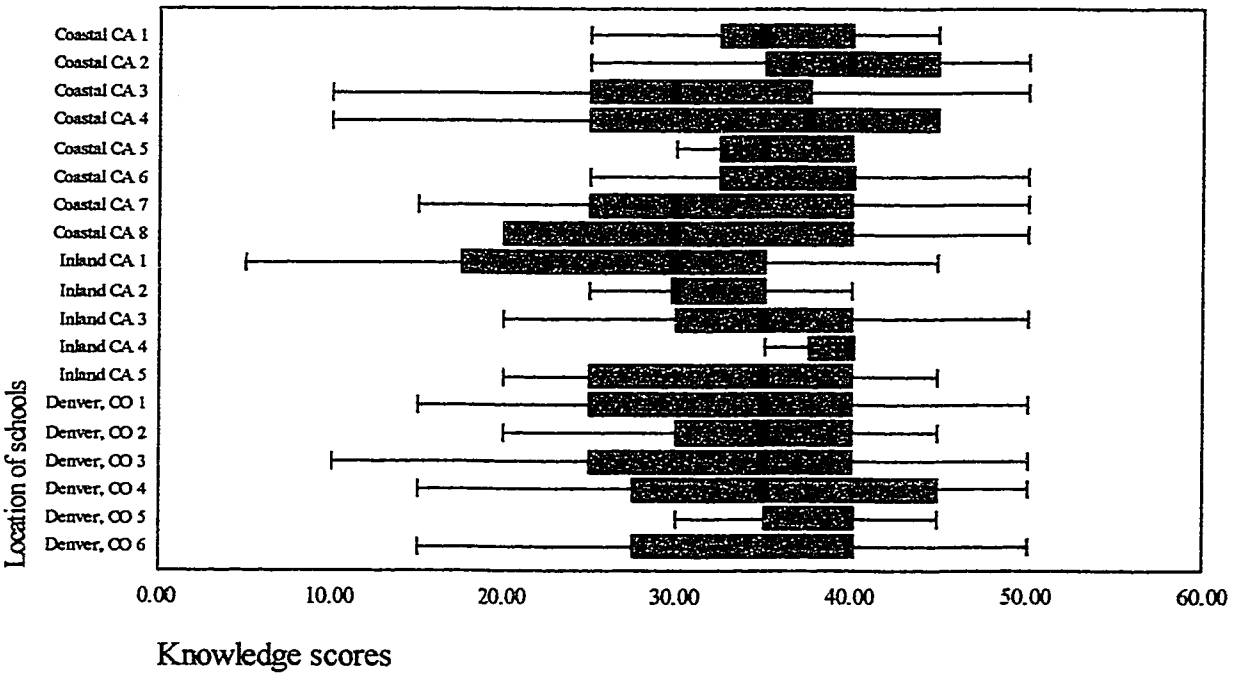
Inland California field trip activities. Four out of five teachers reported they lead field trips to the ocean with students, three of five teachers lead student field trips to a wetland area, and all five teachers lead students on field trips to aquariums.

Denver, Colorado field trip activities. None of the Denver teachers had participated in a field trip to the ocean with students, three out of six teachers lead student field trips to a wetland area, and none had participated in leading students on field trips to aquariums.

Current Baseline Levels: Knowledge

Knowledge scores for the ocean conservation survey were computed by counting the total number of correct answers on the Knowledge section (Questions 3- 12). Five points were given for each correct answer, resulting in scores ranging from 0.00 – 50.00. Table 5 shows the sample mean Knowledge score was 33.64, or 67 percent correct. Mean scores from individual classrooms ranged from a high of 40.00 (80 % correct) to a low of 26.48 (53% correct). Mean scores for all classrooms are listed in Table 5. Figure 1 shows boxplots of Knowledge scores from all classrooms to show range of scores.

Figure 1. Boxplot of Knowledge Score Distribution by Classroom.



The left end of shaded box indicates the 25th percentile of scores, the right end indicates the 75th percentile, and the black bar inside the box indicates the 50th percentile (the median). The mark to the left of the shaded box indicates the 10th percentile of scores, and the mark to the right of the box indicates the 90th percentile of scores.

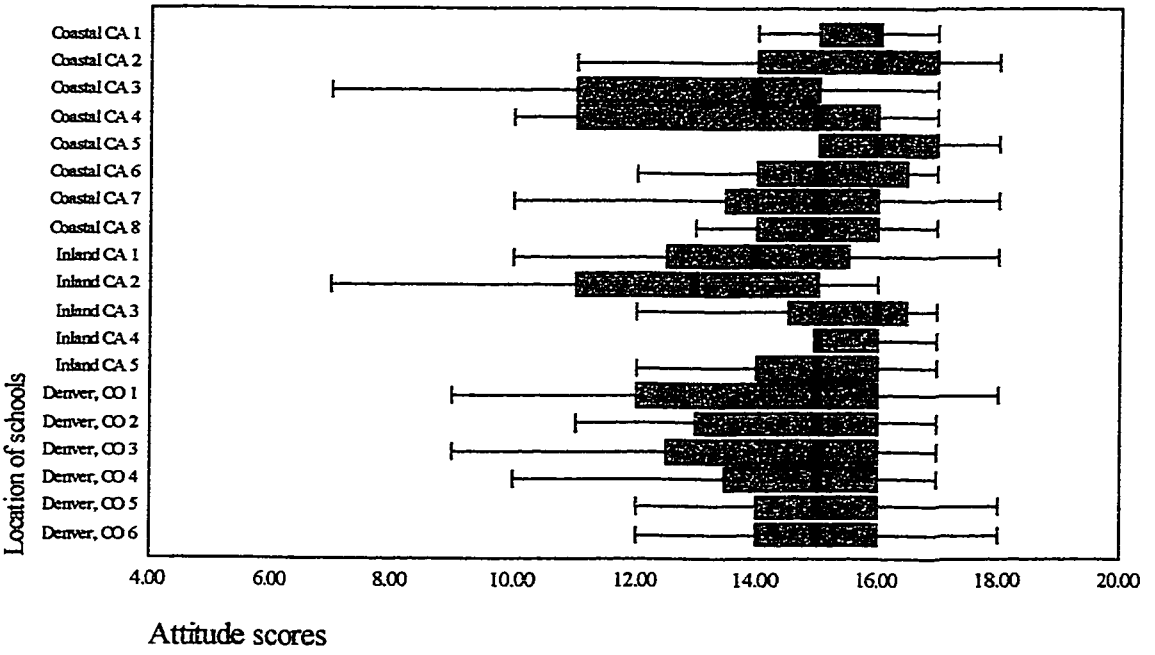
Table 5: Results of Ocean Conservation Survey by Classroom. Table shows Knowledge and Attitude scores: means, standard deviations, and percent.

School Location	n	Knowledge Scores (mean /std.dev.)	Percent Correct	Attitude Scores (mean/std.dev)	Percent Positive
Coastal CA	**180**	**33.92/ 9.14**	**68%**	**14.56/ 2.59**	**81%**
Coastal CA 1	15	36.00/ 6.60	72%	15.60/ 1.30	87%
Coastal CA 2	18	40.00/ 6.86	80%	15.78/ 1.99	88%
Coastal CA 3	28	30.71/ 10.25	61%	13.11/ 2.90	73%
Coastal CA 4	22	34.09/ 10.76	68%	14.00/ 2.62	78%
Coastal CA 5	15	35.33/ 3.94	71%	15.33/ 2.77	85%
Coastal CA 6	24	36.67/ 7.47	73%	14.38/ 3.32	80%
Coastal CA 7	32	31.56/ 9.87	63%	14.69/ 2.06	82%
Coastal CA 8	26	31.35/ 9.33	63%	14.69/ 2.24	82%
Inland, CA	**93**	**32.85/ 9.31**	**66%**	**14.25/ 2.28**	**79%**
Inland CA 1	26	26.48/ 10.54	53%	13.85/ 2.20	77%
Inland CA 2	17	33.24/ 7.06	66%	12.35/ 2.87	69%
Inland CA 3	20	34.75/ 8.50	70%	15.25/ 1.74	85%
Inland CA 4	19	38.68/ 4.67	77%	15.00/ 1.50	83%
Inland CA 5	11	34.50/ 8.64	69%	15.10/ 1.52	84%
Denver, CO	**145**	**33.79/ 10.07**	**68%**	**14.48/ 2.26**	**80%**
Denver 1	25	33.60/ 11.14	67%	14.20/ 2.52	79%
Denver 2	20	32.50/ 9.67	65%	14.65/ 1.66	81%
Denver 3	31	32.26/ 10.87	65%	14.07/ 2.62	78%
Denver 4	24	34.38/ 9.70	69%	14.71/ 2.07	82%
Denver 5	22	36.36/ 9.02	73%	14.32/ 2.75	80%
Denver 6	23	34.13/ 9.96	68%	15.09/ 1.47	84%
Total	**418**	**33.64/ 9.50**	**67%**	**14.46/ 2.41**	**80%**

Current Baseline Levels: Attitude

Attitude scores were computed by counting the total number of points given for each of the attitude questions (Questions 13- 18). Points awarded for each answer ranged from passive (one point), to more active (three points). Attitude scores ranged from 3.00 – 18.00. Table 5 shows the sample mean for the Attitude score was 14.46, or 80 percent positive. This indicates a relatively positive attitude towards the ocean. Table 5 lists Attitude scores for all classrooms and shows that mean scores from individual classrooms ranged from a high of 15.78 (88%) to a low of 12.35 (69%). Figure 2 shows a boxplot of Attitude scores for individual classrooms to show the full range of scores.

Figure 2. Boxplot of Attitude Score Distribution by Classroom.



The left end of shaded box indicates the 25th percentile of scores, the right end indicates the 75th percentile, and the black bar inside the box indicates the 50th percentile (the median). The mark to the left of the shaded box indicates the 10th percentile of scores, and the mark to the right of the box indicates the 90th percentile of scores.

Effect of Location on Knowledge and Attitude Scores

Figure 3a shows Knowledge scores by location. In order to examine the relationship between location and knowledge, an ANOVA was performed with the effect of location on Knowledge scores (n=3: coastal California, inland California, and Denver, Colorado). As Table 6 indicates, results of the ANOVA show no significant statistical difference in Knowledge scores due to the factor of location ($\alpha = 0.05$; $p = 0.66$).

Figure 3b shows Attitude scores by location. In order to examine the relationship between location and attitude, an ANOVA was performed with the effect of location on Attitude scores. Table 6 shows results of the ANOVA which indicates no significant statistical difference in Attitude scores due to the factor of location ($\alpha = 0.05$; $p = 0.60$).

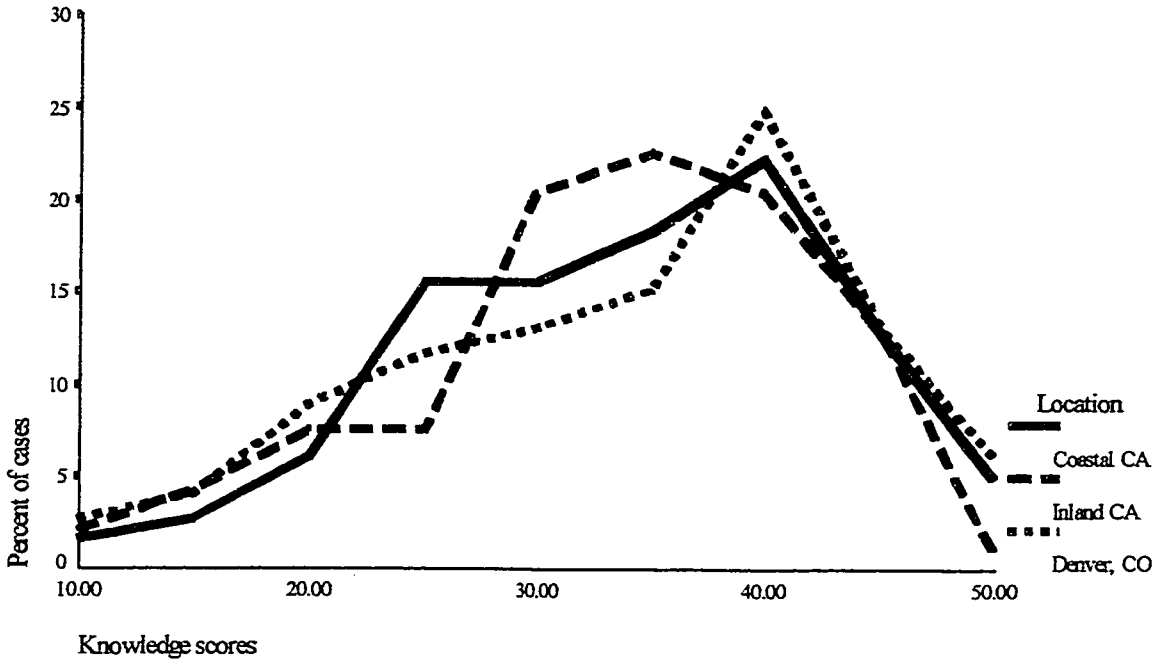
Effect of Gender on Knowledge and Attitude Scores

Figure 4a shows Knowledge scores by gender. A t-test was performed on mean Knowledge scores of males (mean = 33.21) and females (mean = 34.27). Females were found to score significantly higher than males on Knowledge scores ($\alpha = 0.05$; $p = 0.02$).

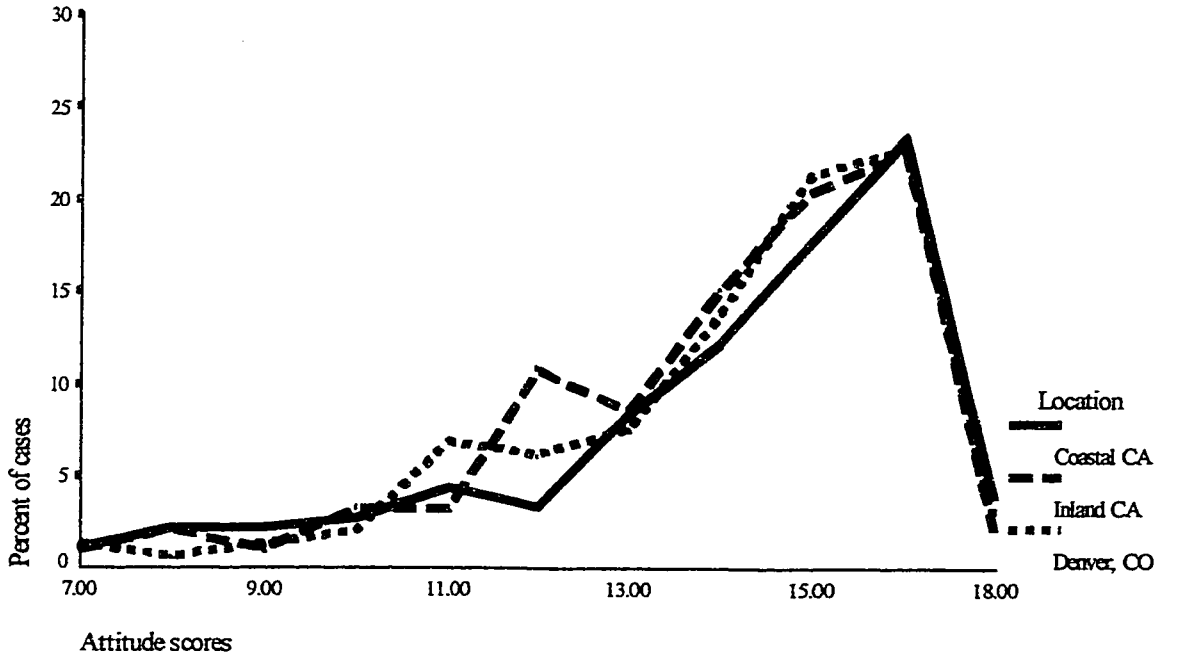
Figure 4b shows Attitude scores by gender. A t-test was performed on mean Attitude scores of males (mean =14.10) and females (mean =14.86). Females were found to score significantly higher than males on Attitude scores ($\alpha = 0.05$; $p = 0.00$).

These findings were not consistent with past research that has also found significant differences on environmental Knowledge and Attitude scores due to gender (Fortner & Teates 1980; Roth & Perez 1992). Those studies found males generally scored higher than females on Knowledge scores.

Figure 3. Mean Knowledge and Attitude Scores by Location. There was no significant difference in Knowledge (a) or Attitude (b) Scores by location.

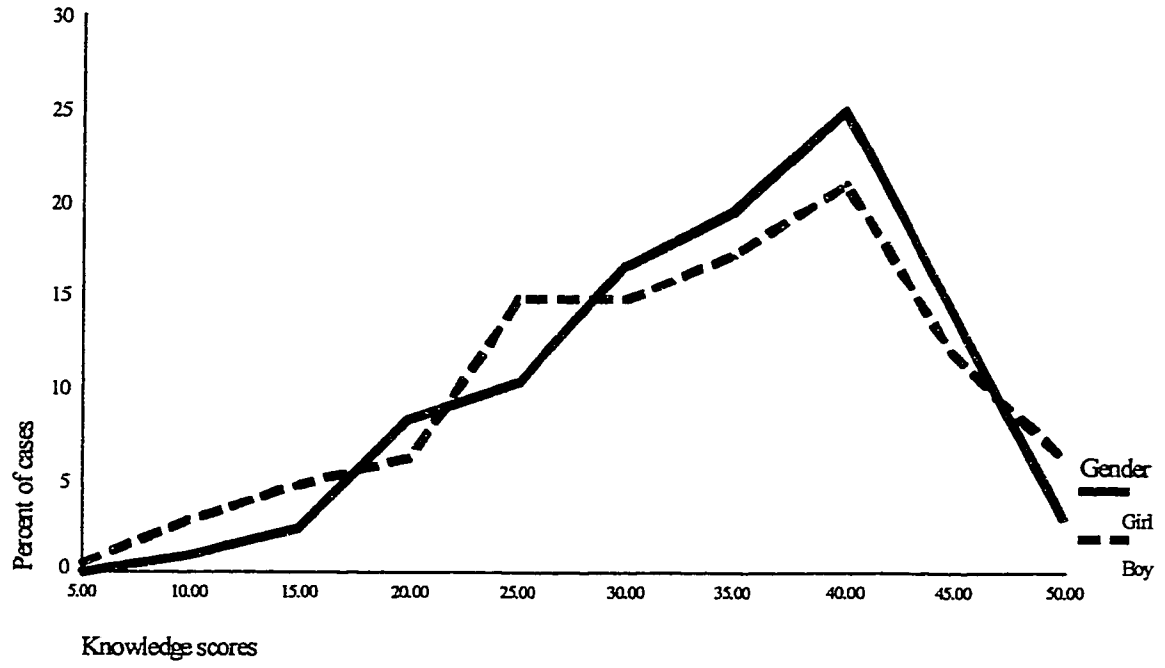


(a)

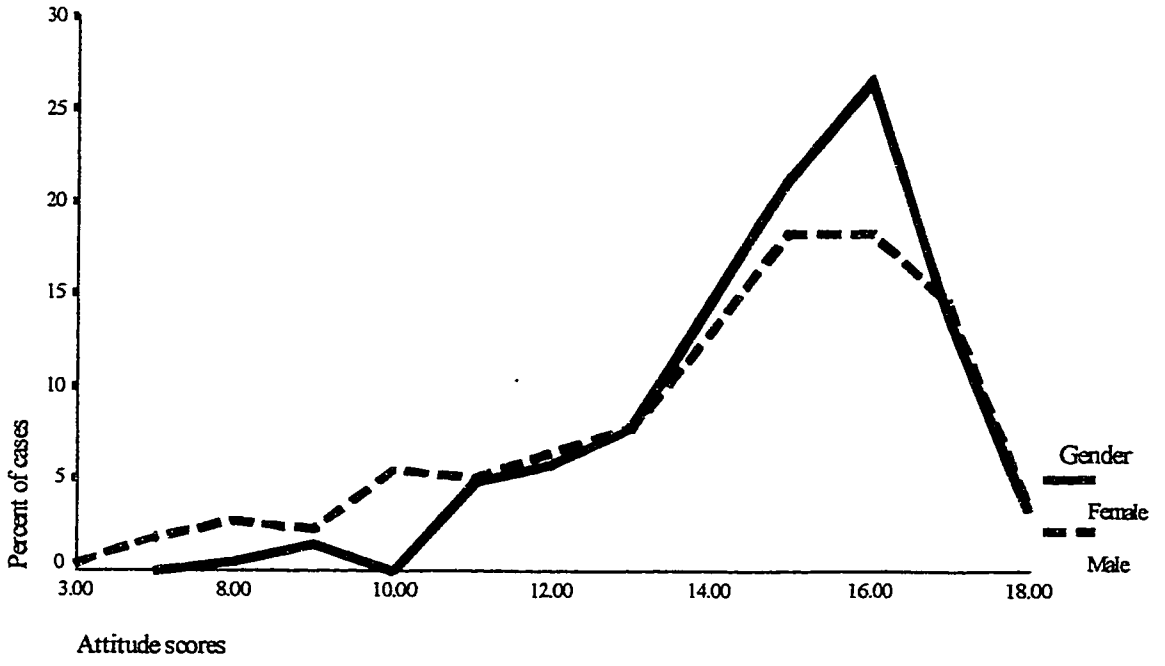


(b)

Figure 4. Mean Knowledge and Attitude Scores by Gender. Females scored significantly higher than males on both Knowledge (a) and Attitude (b).



(a)



(b)

Table 6. Results of an ANOVA Showing Effect of Location. There was no significant difference in Knowledge and Attitude scores due to effect of location.

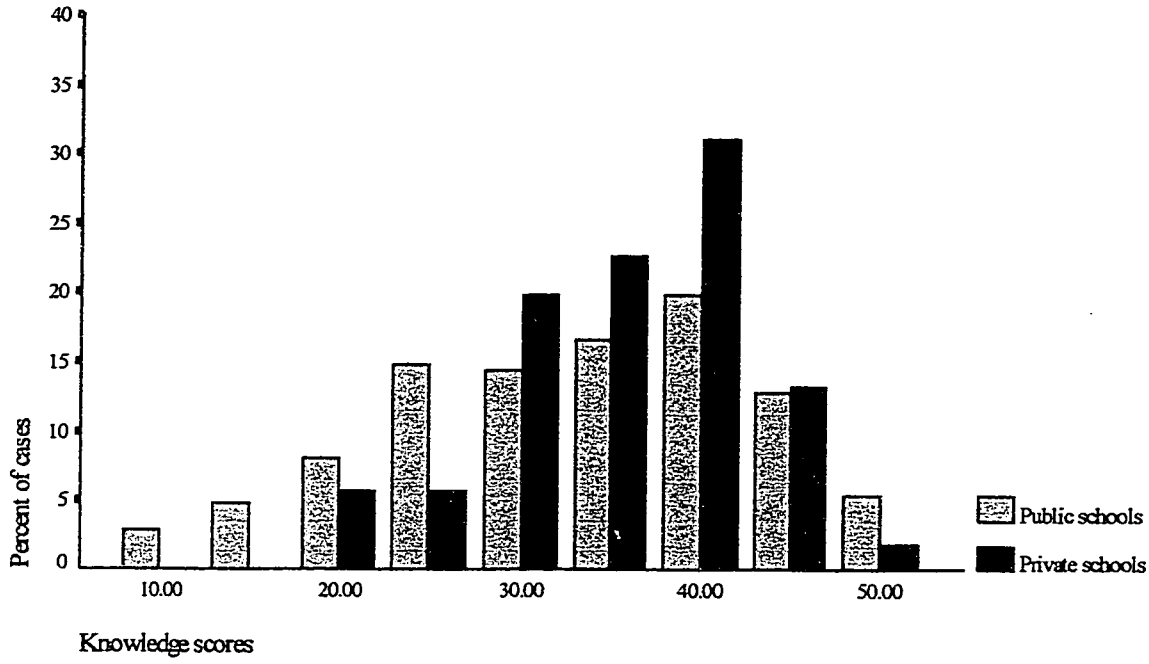
Source of Variation	DF	Sum of Squares	Mean Square	F	Significance of F
Knowledge					
Between Groups	2	75.2917	37.6458	0.4161	0.6599
Within Groups	415	37547.4356	90.4757		
Total	417	37622.7273			
Attitude					
Between Groups	2	5.8868	2.9434	0.5064	0.6030
Within Groups	415	2411.9218	5.8119		
Total	417	2417.8086			

Effect of School Funding on Knowledge and Attitude Scores

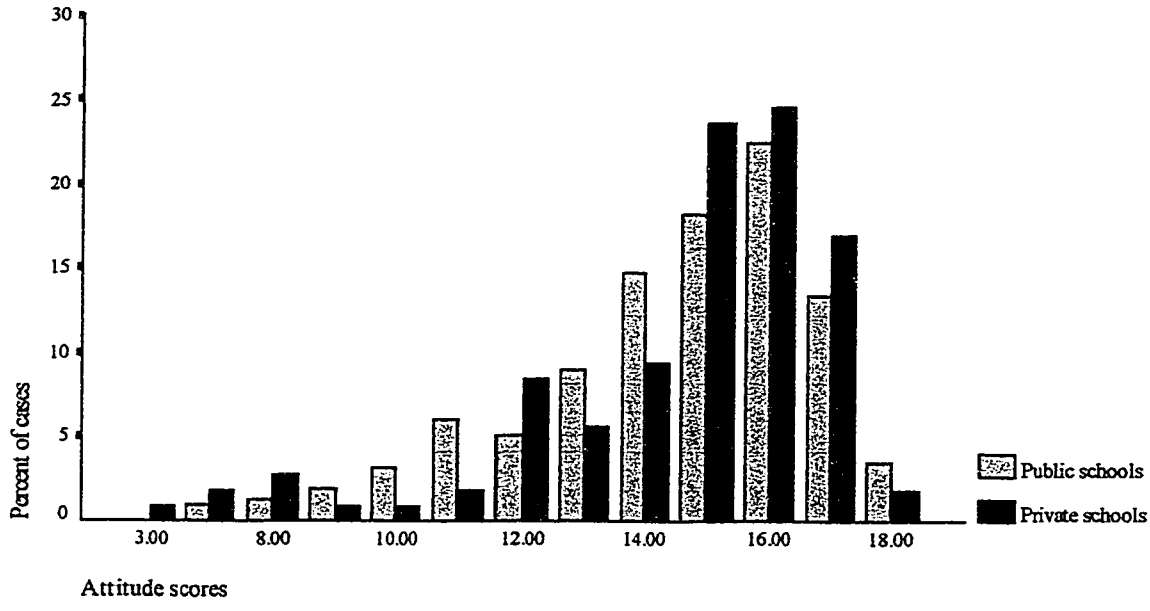
Six of the nineteen classes surveyed were from privately funded schools. Of the six private schools, four were religion-based, one was ethnic-based (Eastern European), and one was based on Montessori teaching. Four of the six private schools were located in the inland California portion of the sample.

Figure 5a shows Knowledge scores by type of school funding. As Table 7 indicates, when an ANOVA is generated with the effect of school funding on Knowledge scores, there is a statistically significant difference in Knowledge scores, with private schools scoring significantly higher than public schools ($\alpha = 0.05$; $p = 0.01$). Figure 5b shows Attitude scores, by type of school funding. Table 7 indicates the results of an

Figure 5. Knowledge (a) and Attitude (b) Scores by Type of School Funding. There was a significant difference between public and private school for Knowledge scores (p=0.01), but no difference in Attitude scores (p=0.70).



(a)



(b)

ANOVA generated on Attitude scores with the effect of school funding shows no significant difference on Attitude scores between public and private school (α= 0.05; p= 0.70).

Table 7. Results of an ANOVA Showing Effect of Type of School Funding. Private schools scored significantly higher on Knowledge scores than public schools. There was no difference in Attitude scores.

Source of Variation	DF	Sum of Squares	Mean Square	F	Significance of F
Knowledge					
Between Groups	1	637.2713	637.2713	7.1678	0.008
Within Groups	416	36985.4560	88.9073		
Total	417	37622.7273			
Attitude					
Between Groups	1	0.8730	0.8730	0.1503	0.699
Within Groups	416	2416.9356	5.8099		
Total	417	2417.8086			

Knowledge - Attitude Relationship

To determine if there was a relationship between Knowledge and Attitude scores, a Pearson product-moment correlation coefficient was calculated. The coefficient was significant (0.26; p=0.00), which indicates a positive relationship between Knowledge and Attitude scores. To further describe the relationship between Knowledge and Attitudes, the sample was divided into cases with higher Knowledge scores, 40.00 or higher (168 cases), and cases with lower Knowledge scores, below 40.00 (250 cases). The cases with higher Knowledge scores had a mean Attitude score of 14.90, while the

cases with lower scores had a mean Attitude score of 14.16. A t-test applied to the two Attitude means shows a significant difference (α=0.05, p= 0.00) between the Attitude score of high Knowledge scores (40.00 or higher), and the Attitude score of low Knowledge scores (below 40.00).

Results of Knowledge Questions

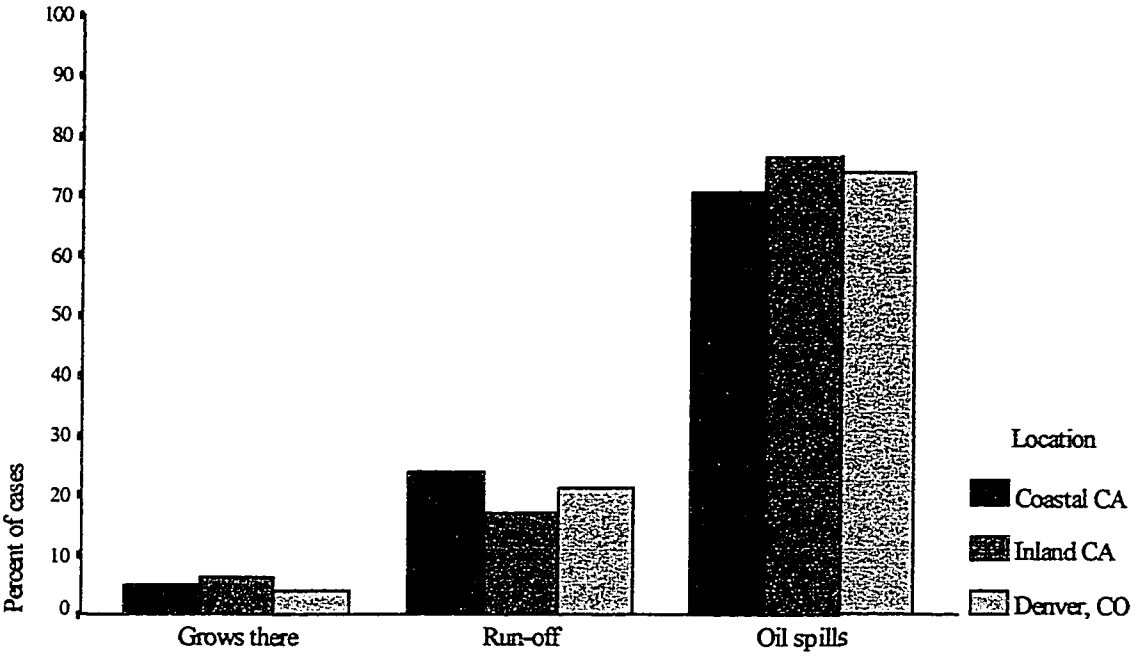
A primary reason for using the fixed-alternative questions on the instrument was to examine what fifth graders understood and what misconceptions existed about ocean conservation issues. Questions about the generic meaning of conservation and sustainability were well understood (over 80 percent of the entire sample scored correct on these concepts). Contrary, questions about aquaculture, diversity, why oceans are important, and ways that humans can harm the oceans resulted in moderately low scores (the entire sample scored in the 60 percent range for these questions). Frequencies of responses of all the knowledge questions, by location, can be found in Appendix C.

Two knowledge questions scored exceptionally low for the entire sample. Figure 6 shows that only 21.7 percent of the entire sample picked correctly that most ocean pollution occurs because "it runs off from the land from rivers and when it rains." Table 8 shows a factor analysis found fifth graders who correctly identified run-off as the cause of most ocean pollution, tended to also correctly answer questions about importance of the oceans and ways humans can harm the oceans correctly with greater frequency.

Figure 7 shows that the question, "Stewardship of the oceans means" had only a 47.0 percent correct response from the entire sample. However, when broken down by

location, the inland California portion of the sample scored higher (58.1%) than the other two locations. Four of five schools from inland California area were private schools.

Figure 6. Response to " MOST ocean pollution occurs because." Only 21.7 percent of the sample answered "run-off" correctly.

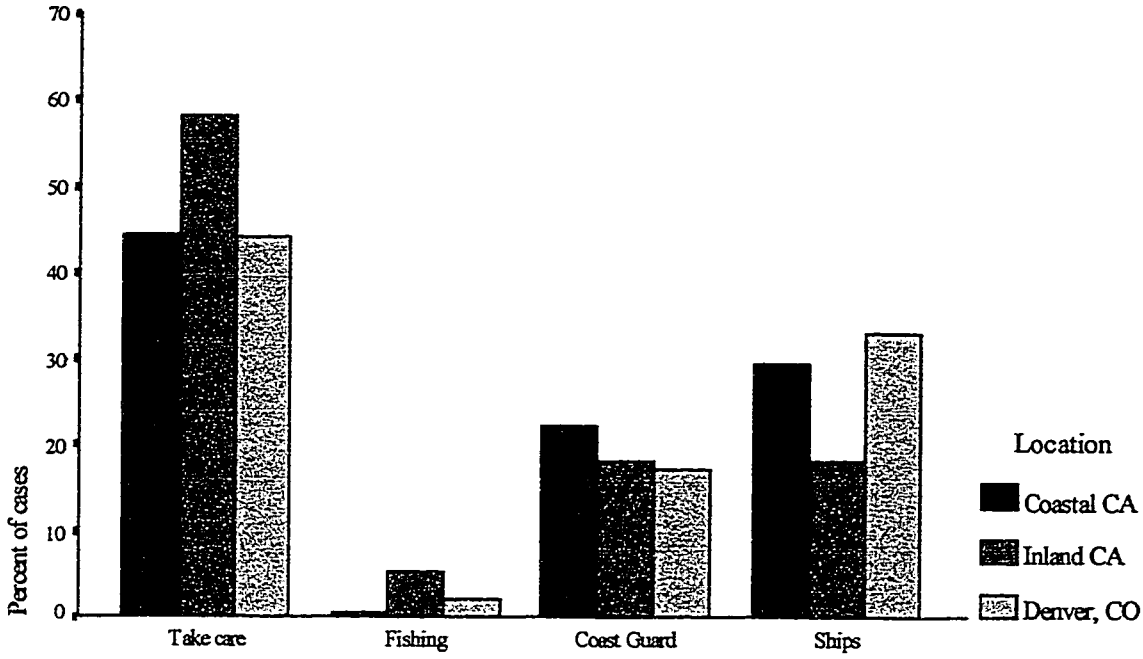


Grows there: it grows there.
Run-off: it runs off the land from rivers and when it rains
Oil spills: ships accidentally dump oil into the ocean.

Results of Attitude Questions

Overall, answers to the six attitude questions were very high for the entire sample (80 %), reflecting positive attitudes and a willingness to participate in activities to protect the oceans. Only 9.8 percent of the sample said they wouldn't be willing to pay

Figure 7. Response to " Stewardship of the oceans means." For entire sample, there was a 47.0 % correct response. Inland California (where 4 of 5 schools were private) had 58.1% correct response.

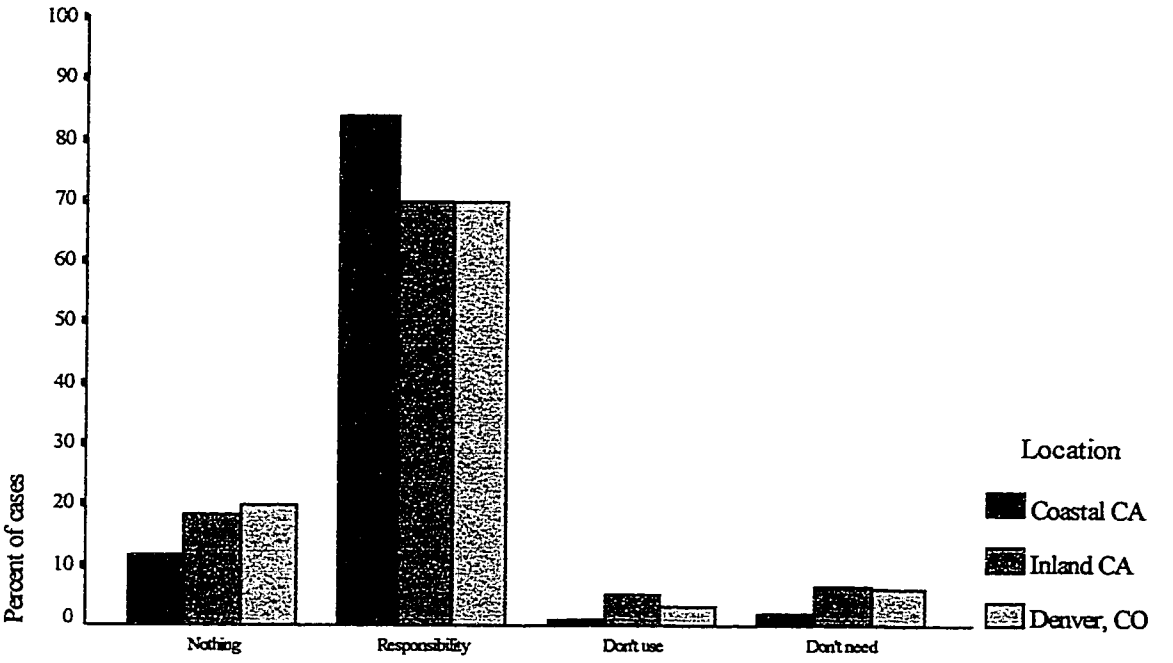


Take care: to take care of the oceans.
Fishing: fishing is good for the oceans.
Coast Guard: the Coast Guard, a group who protects the oceans for us.
Ships: ships that clean the ocean

an "entrance fee" to play at the seashore, while 87.4 percent responded that they would participate in a beach clean-up because either it would be doing something to help the oceans or it would make them feel good. In response to the role of an increasing human population on the oceans, only 5.4 percent answered that a growing human population would have no effect on the ocean, while 56.1 percent answered that it would result in not enough fish to feed everyone and adds too much pollution to the ocean.

Although most fifth graders did not know the definition of the word "stewardship" (only 47.0 percent answered correctly; see Figure 6), when asked about the concept of stewardship, most (75.2 %) answered the question "I should take care of the oceans" with "because it's my responsibility to respect the environment." However, Figure 8 shows that when examined within locations, the coastal California population answered higher (82.1 %) compared with inland California (69.9%) and Denver (69.7 %).

Figure 8. Response to "I should take care of the oceans." Overall, 75.2 % answered with "because it's my responsibility."



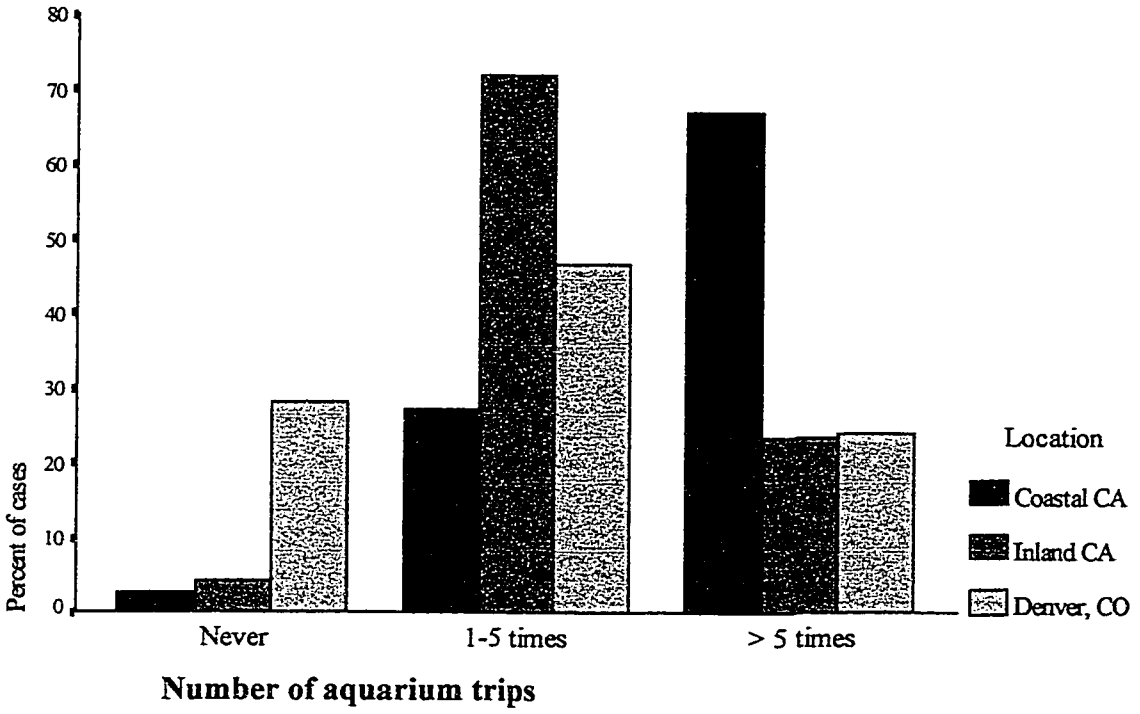
Nothing: but there is nothing I can personally do.
Responsibility : because it's my responsibility to respect the environment
Don't use: but I don't use the oceans, so it's not my responsibility.
Don't need: but I don't need to – the oceans are so big, it's impossible to harm them.

Ocean-Related Experiences and Sources of Information

The frequency of ocean-related activities has been used in the past to examine what activities may contribute to higher Knowledge and Attitude scores on ocean education (Fortner & Teates 1980). This study gathered information on ocean-related activities, to examine what types of activities fifth graders participated in more frequently. The more popular of these activities might then be considered a good method to increase ocean conservation education. Activities investigated included: aquariums, ocean visits, ocean nature films, ocean-related books, boating, swimming, and ocean-related Internet web sites. In addition, several multiple-response questions were included to gather supplementary information on ocean-related interests of fifth graders.

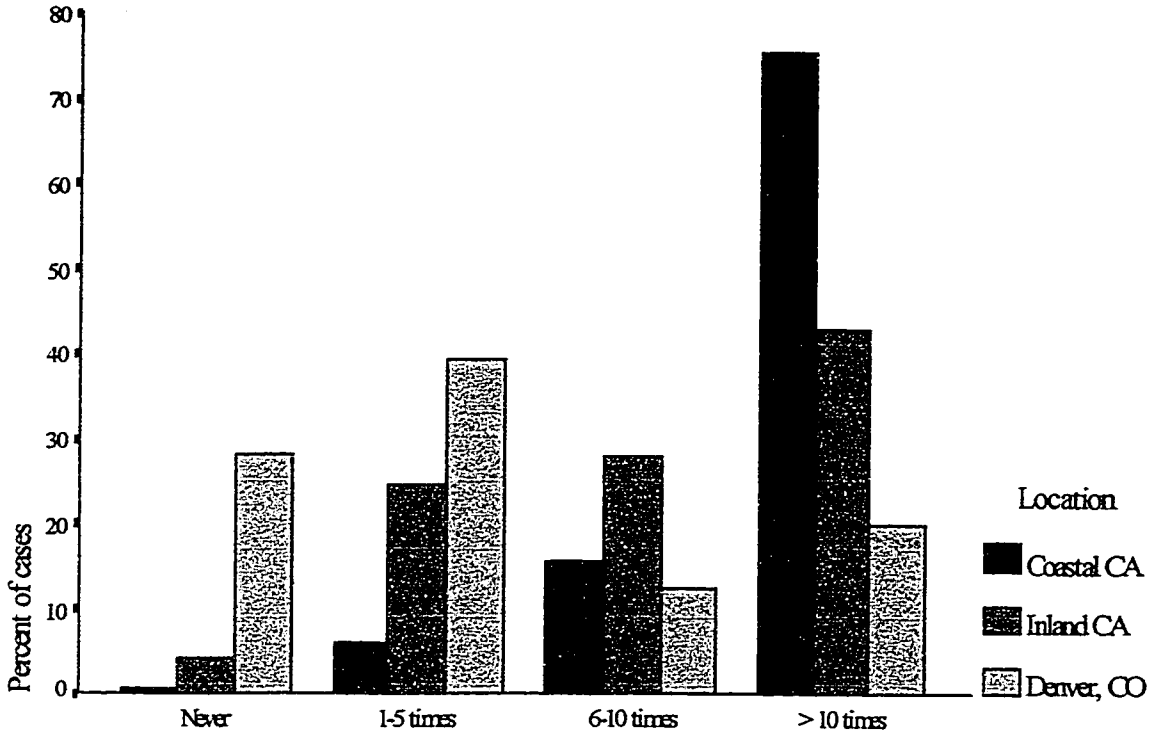
Aquariums. The coastal California portion of this sample lived within an hour's drive of the Monterey Bay Aquarium. The inland California portion of this sample lived within a three-hour drive to the Monterey Bay Aquarium. Therefore, only the Denver portion of the sample did not live near a major aquarium institution. In order to examine if the number of aquarium visits varied between locations, a chi square (χ^2) frequency table was performed. Figure 9 shows a significant difference in frequency of aquarium visits by location resulted ($p=0.00$). Only 2.6 percent from the Coastal California sample responded that they had never been to an aquarium, while 66.3 percent said they had been to an aquarium more than 5 times. In contrast, the Denver sample reported that 28.3 percent had never been to an aquarium, while only 24.1 percent had been to an aquarium more than 5 times.

Figure 9. Frequency of Aquarium Trips by Location. There was a significant difference in aquarium trips by location ($\alpha = 0.05$, $\chi^2 = 129.6$, p=0.00). Only 2.6 % of the coastal California sample reported they never visited an aquarium compared to 28.3 % of the Denver sample.



Visits to the ocean. Living close to the ocean makes visiting the ocean easier, though it doesn't always occur. In the pilot test of this study, Pilot Group 3 lived nearby the ocean, yet reported very few first-hand ocean experiences (refer to Table 1 on Page 27). However, Figure 10 shows that there was a significant difference in frequency of ocean visits among locations. In the coastal California portion of this study, 75.5 percent of fifth graders reported they had visited the ocean more than 10 times, while only 0.5 percent reported they had never been to the ocean. In the Denver sample, only 20.0 percent of the fifth graders reported they had visited the ocean more than 10 times,

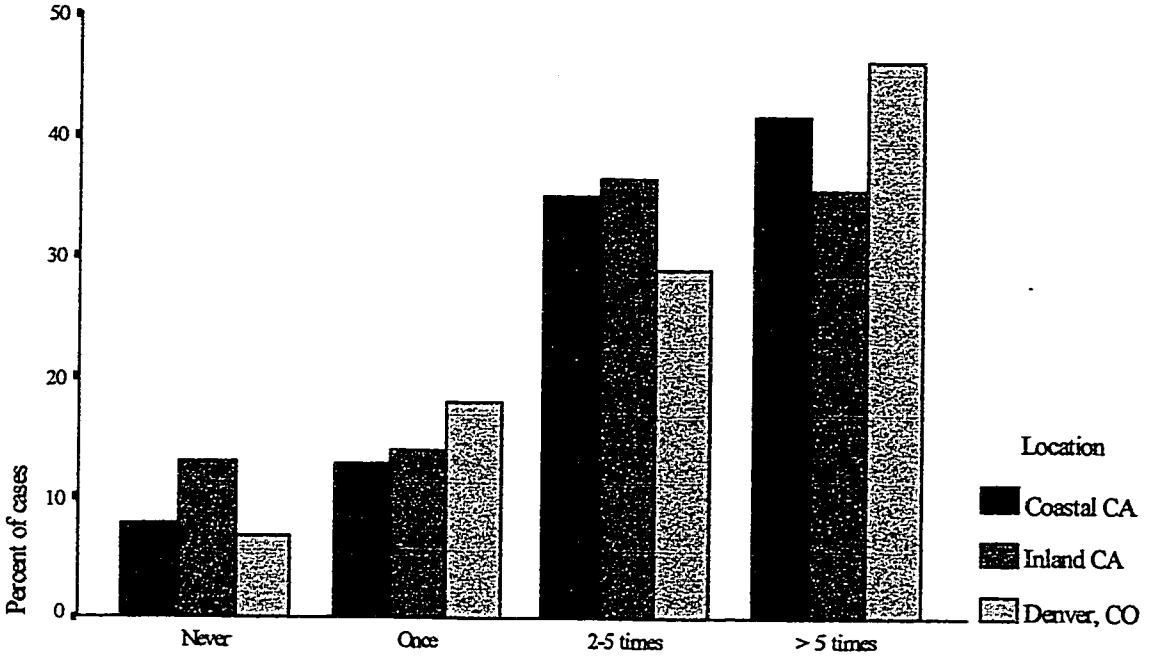
Figure 10. Frequency of Ocean Visits by Location. There was a significant difference in ocean visits by location ($\alpha = 0.05$, $\chi^2 = 167.3$, $p = 0.00$). Only 0.5% of the coastal California sample reported they had never been to the ocean, compared with 28% of the Denver sample.



while 28.3 percent reported they had never visited the ocean.

Boating. The survey question asking, "How many times have you been on a boat" included options of boating on the ocean, river or lake. A chi-square frequency table indicated there was no difference in boating frequency among locations. Figure 11 shows the frequency of "more than 5 times" for boating activity was similar for all three locations, with 41.9 percent of the sample reporting they have been on a boat more than five times.

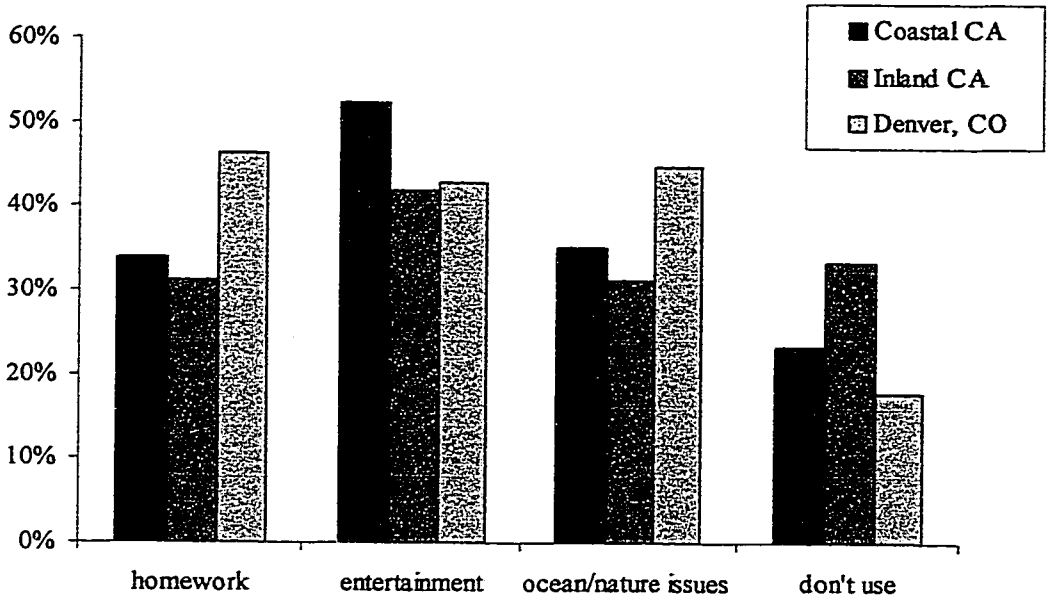
Figure 11. Frequency of Boating Experiences by Location. There was no difference in boating activity due to location ($\alpha = 0.05$, $\chi^2 = 11.38$, $p = 0.18$).



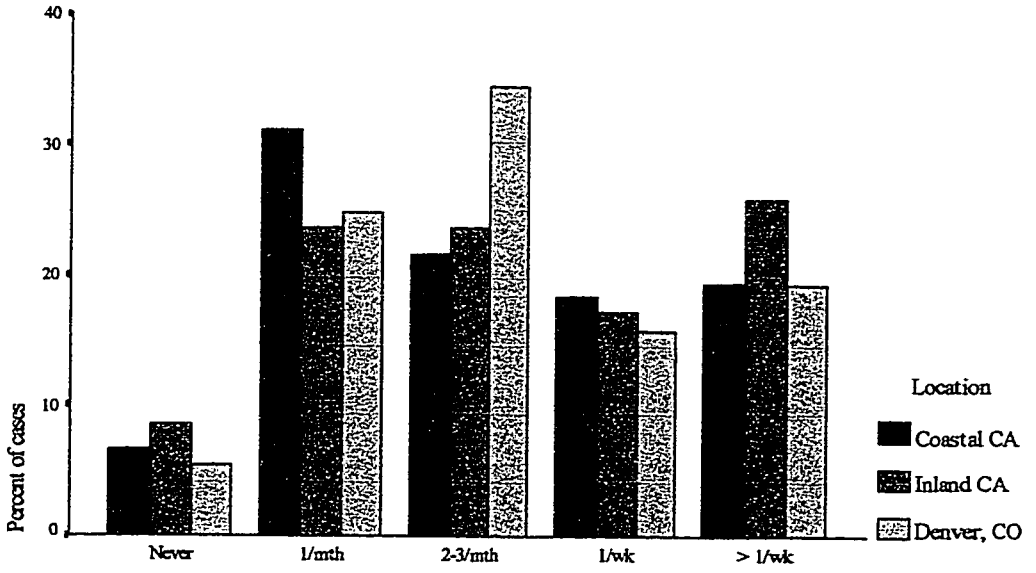
Ocean nature films on television and the Internet. Figure 12a shows that only 23.6 percent of the sample responded that they never use the Internet, while 38.7 percent reported they looked for information about the ocean and other nature issues on the Internet. There were computers in seventeen of the classrooms used in this study (as recorded in field notes by the investigator). Table 8 shows that a factor analysis of ocean-related activities found that those who reported using the Internet to look for ocean or nature web sites, tended to not engage in visits to the ocean or aquariums.

Figure 12b shows responses to the question, "I have seen ocean nature films on television" were similar for all locations. Over a third of fifth graders reported they watch ocean nature films on television at least once a week.

Figure 12. Frequency of Internet usage (a) and Television Viewing (b) of Ocean Films. There was no significant difference among locations.



Internet usage **(a)**



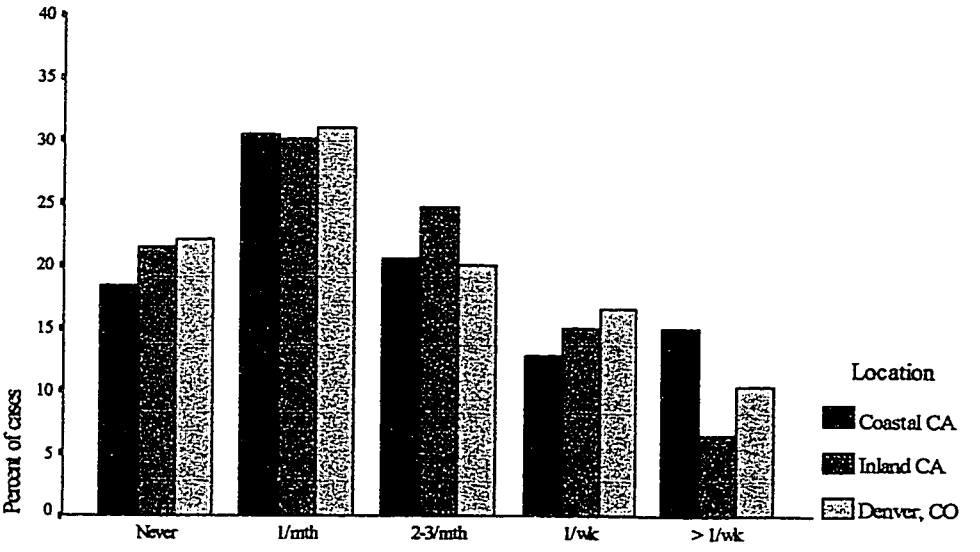
Television viewing **(b)**

Table 8. Factor Analysis for Knowledge Questions (Factor 1) and Ocean-Related Activities (Factor 2).

Variable	Eigenvalue	Factor Coefficient	Percent of Total Variance
Factor 1	**1.575**		**14.748**
Pollution from run-off		0.459	
Importance of oceans		0.607	
Ways humans harm oceans		0.575	
Factor 2	**1.424**		**20.341**
Internet (ocean sites)		0.493	
Aquarium visits		-0.603	
Ocean visits		-0.660	

Books on ocean and marine animals. Figure 13 shows that 21.0 percent of the sample reported they never read ocean-related books. There was no significant difference in ocean book reading among locations.

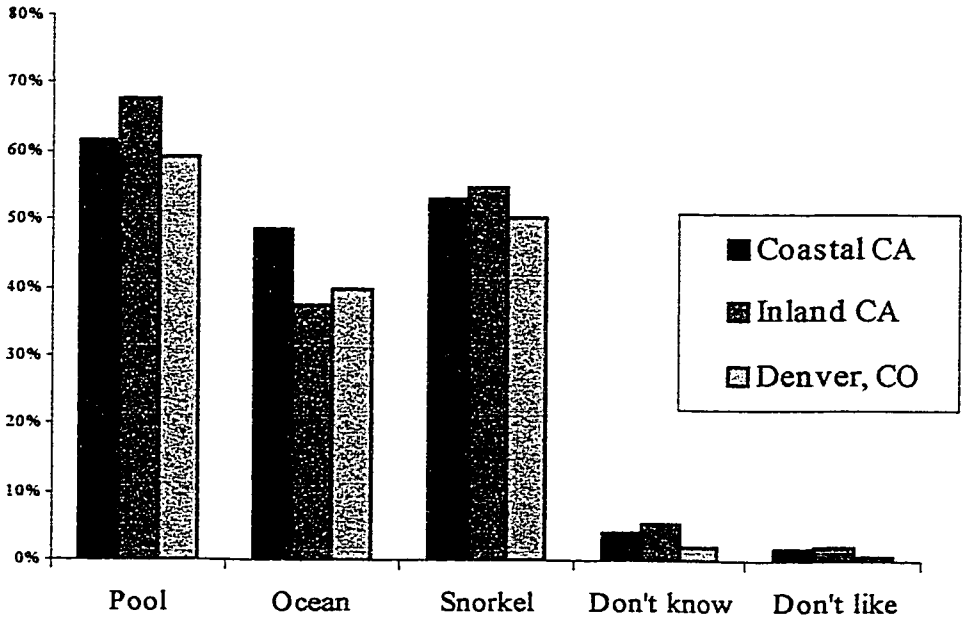
Figure 13. Frequency of Reading Ocean-Related Books by Location. There was no significant difference due to location ($\alpha = 0.05$, $\chi^2 = 10.70$, $p = 0.38$)



Ocean-related book reading

Swimming. The ocean conservation survey gathered information on the swimming activities of fifth graders: if they knew how to swim, and if they liked swimming in the ocean or a swimming pool. Figure 14 shows that most fifth graders reported they knew how to swim (this was a multiple response question). There was no significant difference among locations, with only 5.3 percent from the coastal California sample, 7.6 percent from the inland California sample, and 2.8 percent from the Denver sample reported they didn't know how or didn't like to swim.

Figure 14. Frequency of Swimming Activity by Location. There was no significant difference due to location. Most fifth graders reported they knew how to swim.



Activities Contributing to Higher Knowledge and Attitude Scores.

Multiple regression analyses (stepwise) were performed to determine if there was a relationship between higher Knowledge scores, and aquarium visits, visits to the ocean, ocean-related internet usage, ocean book reading, ocean film watching, boating, swimming in a pool, swimming in the ocean, snorkeling, wanting a job related to the oceans, and wanting to become a marine biologist. An R^2 value of 0.13 was found to explain higher Knowledge scores from aquarium visits ($p=0.02$), reading books ($p=0.02$), boating ($p=0.03$), swimming in a pool ($p=0.00$), snorkeling ($p=0.01$), and wanting to become a marine biologist ($p=0.01$).

The same activities were then performed in a multiple regression for positive Attitude scores. An R^2 value of 0.14 was found to explain positive Attitude scores from aquarium visits ($p=0.00$), ocean-related Internet usage ($p=0.00$), and wanting to become a marine biologist ($p=0.00$).

An R^2 value of 0.13 and 0.14, representing 13 percent of the variability of higher Knowledge scores, and 14 percent of the variability of higher Attitude scores, does not appear to be a high value. However, a sample size of 418 gives a greater significance to the activities contributing to higher Knowledge and Attitude scores.

Multiple-Response Questions

Several multiple-response questions were included in the survey to gain a better understanding of how fifth graders feel about the oceans. Two-thirds of fifth graders responded they would like to live by the ocean when they grow up because they love the

ocean and would like to spend more time there. When asked about good reasons to protect the ocean, 51 percent responded because it may provide the cure for cancer, 50 percent responded because it's beautiful, 47 percent responded because it's for the good of the planet, and 41 percent responded because it provides food. When asked about eating fish, a third of fifth graders don't like to eat fish, while 43 percent responded they like the taste. Finally, when asked what they could do to protect the ocean, 51 percent of fifth graders responded to learn more about it, 32 percent responded to save allowance and donate to environmental groups that protect the oceans, and 22 percent responded to write letters to Congressmen. Complete results of the multiple response questions are in Appendix C.

Qualitative Findings

The ocean conservation survey also included three open-ended questions, which many teachers had suggested as an appropriate way to gather additional information from fifth graders regarding their knowledge and attitudes about the ocean. Nearly all of the fifth graders completed the open-ended questions of the survey.

Answers to the question "List some words, or a sentence that describes how you feel about the oceans" were generally positive. Sample answers included:

- It's beautiful.
- There shouldn't be pollution there.
- Sad, fun, cold, dangerous.
- Happy, delighted, peaceful.
- I love the ocean and hate to see it put to waste.
- Needs to be protected.

Most answers to the question "What interests you about the oceans that you would like to learn more about" included specific marine life, for example, whales or the kelp forest. Other answers to what interests fifth graders about the oceans, besides specific animals included:

- The photic zone
- Shipwrecks
- How to protect the ocean
- How the ocean became the ocean
- Underwater volcanoes
- How to become a marine biologist
- How to stop polluting

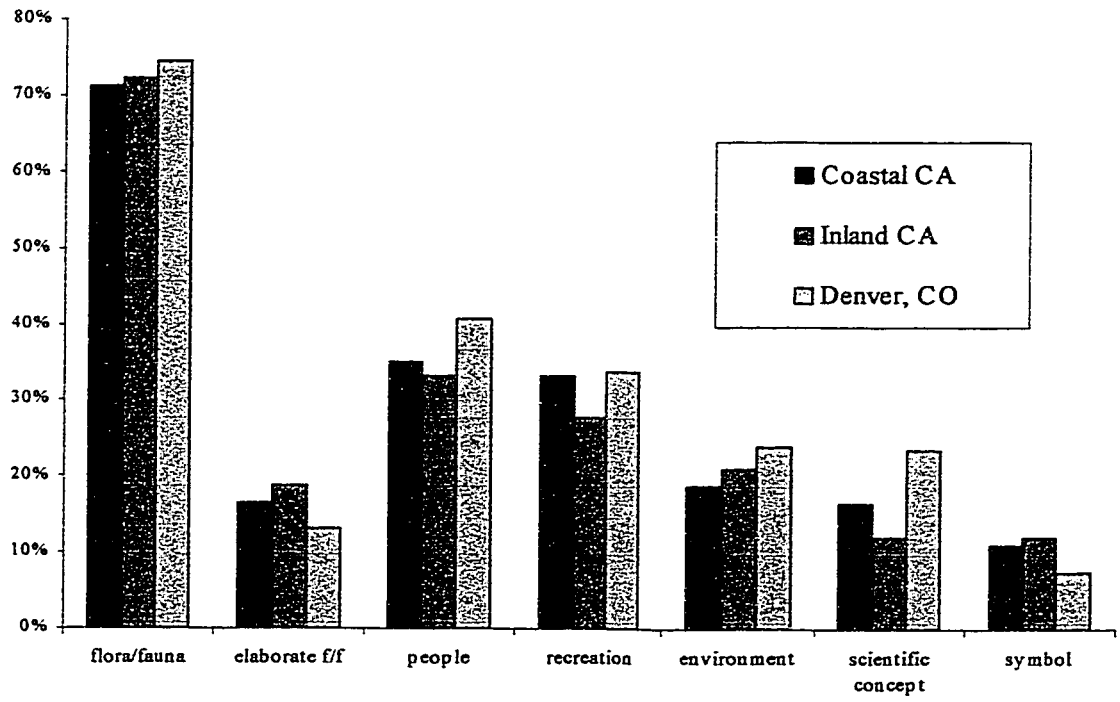
The final open-ended question involved drawing a picture of "what the oceans mean to you." Very few completed surveys did not contain a drawing, though approximately ten percent of the students had approached the investigator during the administration of the survey and claimed they did not know what to draw. Meanwhile, several teachers had to limit the time for completing the survey, as some students were deeply absorbed in the drawing.

This thesis does not attempt to thoroughly evaluate artwork produced in the ocean conservation survey. For this study, the analysis of the drawings was limited to examining the frequency of responses of categories included in each artwork.

The art categories included: flora and fauna, additional (or elaborate) flora and fauna, people, recreation, scientific concept (such as a food web), the environment or environmental concern (debris on beach), and symbols (often a happy face or heart shape). Seventy-two percent of the cases contained the flora or fauna category. Figure 15 shows frequency of responses from the entire sample. There were no significant

differences in frequencies of any of the categories, though the coastal California artwork tended to contain more detailed marine life. Examples of artwork from the student survey can be found in Appendix D.

Figure 15. Frequency of Art Categories in Student Drawings. Over 70% of drawings contained the flora and fauna category, though most drawings had more than one category.



CHAPTER 5

DISCUSSION

This study provided baseline information on the level of ocean conservation knowledge and attitudes of fifth graders in three locations: central coastal California, inland California, and Denver, Colorado. It was found in this research that, although fifth graders do not have a high level of knowledge about ocean conservation issues, they do have positive attitudes about the ocean. Fifth graders also have a willingness to participate in activities that promote healthy oceans, which suggests they do have the potential to become tomorrow's stewards of the ocean.

Although 85 percent of fifth graders reported they had learned something about the oceans at school, overall they scored moderately low on the knowledge section of the ocean conservation survey. While 76 percent of the teachers reported they taught ocean ecosystems to fifth grade classes, this research suggests that ocean conservation issues have not been the primary focus of any ocean education curriculum. Whereas 80 percent of fifth graders responded they read ocean-related books, if most ocean curricula and books are based on marine science, not ocean conservation, then consistently low Knowledge scores on the ocean conservation survey are not unexpected.

Ocean visits were significantly more frequent with coastal students than non-coastal students. However, no significant difference in Knowledge and Attitude scores between coastal locations and inland locations were found, indicating there are other factors, not first-hand experiences at the ocean, contributing to higher Knowledge and Attitude scores on ocean conservation.

Females scored significantly higher on Knowledge and Attitude scores, which differs from past research, which found males typically scored higher on knowledge (Fortner & Teates 1980; Roth & Perez 1992). Perhaps conservation attitudes are more "nurturing" and "caring," which may explain why females tended to have more positive Attitude scores on the ocean conservation survey. In addition, females may feel there are now more opportunities for ocean-related jobs and therefore are more interested in ocean issues.

Private schools scored significantly higher than public schools on Knowledge scores, though no activities were identified that contributed to higher scores in private schools. This is an area of research for further study, to examine if characteristics associated with private schools (increased parent involvement, higher income levels, access to greater technological resources, frequent field trips, or smaller teacher-student ratios) could be contributing to higher Knowledge of ocean conservation issues.

In general, fifth graders had very positive attitudes regarding ocean conservation. Past research has shown that increased knowledge about environmental issues does not lead to changed behaviors (Hungerford and Volk 1990). However, this study found a positive correlation between increased knowledge of ocean conservation, positive attitudes, and a willingness to participate in actions that promote healthy oceans. Although Hines et al. (1986) list knowledge of environmental issues as only one component of positive attitudes, the positive correlation found in this study seems to suggest that a willingness to participate could result from increased knowledge. Nevertheless, having positive attitudes, and a verbal commitment to actions that promote

healthy oceans does not necessarily change behaviors to ocean stewardship. This study investigated what actions fifth graders said they were willing to participate in to promote healthy oceans. As baseline data, these results can be used as a comparison to later studies of verbal and actual commitments.

Only 9.8 percent of fifth graders responded that they would not pay an "entrance fee" to play at the beach. In the future, perhaps it will be realistic to charge a user-fee at the National Marine Sanctuaries as we do at Yosemite, Yellowstone, and other national parks. Children would not necessarily by expected to pay for these "experiences" out of their own allowance. However, treating protected waters in the same manner as protected parks may lend the oceans the value they are worth, and encourage children to engage in stewardship activities as environmentally conscious adults.

Participating in a beach clean-up was an action that was overwhelmingly acceptable to fifth graders. Only 3.1 percent said this was something they would not want to do. There was no difference among locations, suggesting that a beach clean-up is an activity that could encourage and promote ocean stewardship. "Beach" clean-up campaigns should include rivers and lakes, to take advantage of students in non-coastal locations.

Fifth graders were asked what personal actions would help to protect the oceans. They responded to certain actions with greater frequency than adults surveyed in the Mellman Group study (SeaWeb 1996). Overall, 51 percent of fifth graders responded that learning more about the ocean was a good way to protect the ocean, compared with 26 percent of adults. Thirty-two percent of fifth graders responded that saving part of

their allowance to donate to environmental groups would help the oceans, compared to 12 percent of adults (who generally have less "discretionary" income for charity). Twenty-two percent of fifth graders responded that writing letters to Congressmen is a good way to protect the oceans, compared with 18 percent of adults. These are all personal actions that are suitable for fifth graders to achieve (increasing knowledge of ocean conservation issues, saving part of their allowance, writing letters) that could be easily incorporated into education materials to encourage stewardship.

Several misconceptions about ocean issues were consistent throughout the sample and should be taken into account when developing ocean conservation education. A total of 73 percent of the sample thought that most ocean pollution occurred from oil spills. The Mellman Group found that 81 percent of adults also felt that oil spills were the most serious problem of the oceans (SeaWeb 1996). This is most likely because oil spills attract the most media attention (Niebuhr 1998; Ozawa 1996). However, the largest amounts of pollutants discharged into the oceans are from run-off and land-based pollution sources (Frankel 1995; Klee 1999).

The definition of the word "stewardship" was answered correctly by only 47 percent of those sampled. However, most fifth graders (75.2 %) understood the meaning of the concept of stewardship. Though the word "stewardship" is used frequently in environmental messages, acts of "stewardship" are often thought of in a religious context. The inland California portion (where four of five schools were private, of which three were religious) scored higher on this question, suggesting that the word "stewardship" is not part of fifth graders environmental vocabulary, but rather has religious connotations.

Other questions indicated a moderate level of knowledge about the benefits of aquaculture (62.9% correct), the biological diversity of coral reefs (65.4 % correct), resources of the ocean (64.0% correct), and the totality of negative human impacts on the oceans (69.2 % correct). These topics involve relevant current issues regarding conservation of the oceans and could be easily incorporated at the fifth grade level into not only science but also into social studies, math, history, and art.

This study investigated ocean-related activities to determine if any were a source of information contributing to higher Knowledge and Attitude scores. It was found that aquarium trips and visits to the ocean were the only activities that were more frequent with coastal students. However, coastal students did not score higher on Knowledge scores. It was found that all fifth graders engaged in boating trips, reading ocean books, watching ocean nature films on television, Internet usage, and swimming with the same frequency.

Fortner & Teates (1980) found that students (Virginia tenth graders) perceived marine-related television programs and movies to be their greatest influence on their knowledge of the oceans. In that study, it was found that ten percent of the variation in Knowledge scores could be accounted to the number of Cousteau specials seen on television. Yet, in a later study, Fortner & Lyon (1985) found that positive attitudes gained from viewing a Cousteau special returned to pretreatment levels just two weeks after viewing. Television viewing was not a factor in higher Knowledge and Attitude scores in this study. However, since 1980, several major changes in television and

information technology have occurred, with the addition of cable television and the invention of the Internet, which may have decreased its impact.

This research found that aquarium visits, boating, books, swimming in a pool, snorkeling, and wanting to become a marine biologist contributed the most to higher Knowledge scores in fifth graders. None of these activities requires coastal access, suggesting that ocean conservation education does not need to be confined to coastal locations. With recently opened aquariums in coastal and non-coastal locations, these types of institutions could contribute substantially to increasing ocean conservation awareness and education.

Boating and swimming are other activities that can take place in a pool, lake, river, or ocean and which could increase conservation awareness and education. In addition, some ocean recreation activities (surfing, snorkeling, and scuba diving) are dependent on the ability to swim. Besides Fortner & Teates (1980), little research has been done on the relationship among swimming ability and knowledge and attitudes of the oceans, yet this is an interesting topic for possible further study. The ability to swim may affect children's fears about water, and therefore the ocean, and their feelings to protect it.

Though there is a variety of ocean curricula for the fifth grade level, no major publishers of public school textbooks publish books on ocean education for grades K-12 (NOAA 1998). Although it appears that books used in school activities did not contribute to higher Knowledge scores on ocean conservation, fifth graders who reported they read more ocean-related books, did score higher. Roth and Perez (1992) also found

that students who reported more "private reading" scored higher on knowledge sections on environmental issues. This indicates that books can increase knowledge about ocean conservation, and books based on ocean conservation should be included in formal and non-formal ocean-education programs.

Aquarium visits, ocean-related Internet web sites, and wanting to become a marine biologist contributed to more positive Attitude scores. None of these activities require ocean access. Fifth graders who responded they used the Internet for ocean-related web sites were more likely to have reported fewer aquarium and ocean visits. This suggests that using the Internet to find information about the oceans is an activity that is used more frequently with non-coastal fifth graders, who have less direct access to the ocean and aquariums. Since aquariums also contributed to increased knowledge and positive attitudes, this research indicates that a highly interactive aquarium web site could become a significant ocean conservation educational tool.

Finally, the results of this study provide an excellent opportunity for evaluating the effectiveness of FOTO materials on a national basis. Since first-hand experiences of visiting the ocean appears to be insignificant for increasing ocean conservation knowledge and attitudes, this research suggests that this type of educational product will be well received in non-coastal, as well as coastal locations.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

The data gathered for this study answered the following six research questions:

1. What is the current level of ocean conservation knowledge of fifth graders in the study areas?

This study found that fifth graders have only a moderate knowledge of ocean conservation issues (67% correct on the knowledge section of the survey). In addition, there are important environmental concepts regarding the oceans that are not understood accurately. For example, run-off (from land) into the oceans was not seen to be a major source of pollution – a clear indication that ocean conservation education has been ineffective. A comprehensive, ocean conservation program would highlight these misconceptions and then should emphasize how personal actions can alleviate problems. For instance, one might explain how pesticides used on lawns and gardens can end up in the ocean and then introduce skills on how to apply pesticide-free home gardening practices.

2. Do fifth graders in the study areas have positive attitudes and a willingness to participate in actions that protect the ocean?

Answers to the attitude questions were high for the entire sample (80 percent positive), reflecting positive attitudes and a willingness to participate in activities to protect the ocean. Most fifth graders (87.4 %) responded that they would participate in a beach clean-up because it would be doing something to help the oceans or make them

feel good. The skills to accomplish these types of actions should be included as part of all ocean education programs. Additionally, ocean education programs should change the focus of information from "doom and gloom" which leads to a feeling of helplessness to a more positive understanding of how personal actions can help maintain healthy oceans.

3. Does proximity to the coast influence Knowledge and/or Attitude scores on the ocean conservation survey?

There was no significant difference in Knowledge or Attitude scores among inland and coastal locations. Although as a group coastal California subjects reported more aquarium and ocean visits, those experiences alone did not factor in higher Knowledge or Attitude scores on ocean conservation.

This study indicates that non-coastal fifth graders have a high interest in the oceans and a strong desire to visit or live near the coast. With increasing human pressures on the ocean's resources, an educated public is needed to support conservation actions and policies. Therefore, ocean conservation education should not be limited to coastal areas.

4. Do fifth graders who have higher Knowledge scores also have more positive Attitude scores on the ocean conservation survey?

There was a positive relationship between Knowledge and Attitude scores. Fifth graders who scored higher on the knowledge section (over 80% correct) scored significantly higher on the attitude section. However, this study only measured self-reported attitudes and behaviors of fifth graders. To help evaluate education programs,

this relationship would need further investigation through observed commitments and actions.

5. Does the gender, or type of school attended affect Knowledge and/or Attitude scores on the ocean conservation survey?

Females scored significantly higher than males on both Knowledge and Attitudes. This contrasts past research, which has shown males to score higher on knowledge of environmental issues. In addition, private schools scored significantly higher than public schools on Knowledge with no significant difference in Attitude scores. More research is needed to understand what factors of private schools lead to greater knowledge of ocean conservation.

6. What experiences and sources of information are related to fifth graders higher Knowledge and/or Attitude scores on the ocean conservation survey?

The experiences and sources of information relating to higher Knowledge scores included aquarium visits, boating, books, swimming in a pool, snorkeling, and wanting to become a marine biologist. None of these activities requires coastal access, suggesting ocean conservation programs should not be limited to coastal locations.

Experiences relating to higher Attitude scores in this study included aquarium visits, ocean-related Internet usage, and wanting to become a marine biologist. Although higher frequency of aquarium visits did not factor in higher Knowledge and Attitude scores for the coastal California group, visits to an aquarium did contribute to higher Knowledge and Attitude scores of the entire sample. Most of the California fifth graders (coastal and inland, which accounted for 65% of the sample) reported visiting the

Monterey Bay Aquarium (personnel communication with survey respondents). This suggests the Monterey Bay Aquarium has contributed to increased knowledge and positive attitudes of ocean conservation of fifth graders in California.

There is a great need for more research and evaluations of ocean conservation programs. The survey developed for this study was designed around general issues so that it could be used with a wide-range of ocean education programs and conservation activities. The survey can be used in its current form as a pre- and post-test evaluation of a conservation activity or education program. Alternatively, the survey could be used in a larger, more random sample to build on the data collected for this study.

Before collecting more data with the ocean conservation survey, the following are recommend:

- Focus groups with fifth graders and fifth grade teachers to explore further ocean conservation topics for expanding the ocean conservation survey.
- Expand attitude questions to focus on what factors encourage fifth graders to act more positively towards conservation actions. Possible factors: parents, school, peers, community groups, self-interest, or others.
- Include questions on how often, and what types of conservation activities fifth graders engage in presently: beach clean-ups; recycling of bottles, cans, newspapers; conserving water and electricity; and writing letters to politicians.
- Include questions about what experiences contribute to fifth graders feeling like they are making a difference to maintain healthy oceans.
- Add to the survey detailed questions on what type of teaching and learning occurred on ocean topics: what methods and publications were used, what ocean subjects were covered, and what grade learning occurred.
- Include the option of "I am a vegetarian" for question "I like to eat fish because."
- Increase the use of qualitative information by expanding evaluation of artwork.

In addition, it is recommended that Monterey Bay Aquarium use existing data from this study to implement the following:

- The baseline data collected in this study should be used in a follow-up longitudinal study with FOTO teachers, to examine if there is a significant improvement in Knowledge and Attitude scores in fifth grade classes utilizing the FOTO books.

- Expand the evaluation stage of FOTO to a national level with other conservation-oriented aquariums. As a start, the Colorado Ocean Journey has indicated to this investigator an interest in using FOTO products with their school programs.

- Increase education of important ocean conservation issues such as the impact run-off has on the ocean. This could be included as part of FOTO products and other education programs and activities within the aquarium.

- Evaluate school programs from a conservation-based approach to examine what conservation messages children are receiving from a school visit to the aquarium.

- Create action-based activities for schools to access through the MBA web site. For example:
    1) Sponsor a beach clean-up and report results of what schools found on the MBA web site.
    2) Create interactive conservation-based research projects (for example a wetland restoration project) where students collect data and send it to a scientist via the MBA web site.
    3) On the MBA web site, post ocean conservation action alerts aimed at children, encouraging them to write letters to their Congressmen.

Any further research that adds to the limited data available on knowledge and attitudes of ocean conservation would be enormously helpful to environmental educators who are trying to increase awareness of ocean conservation issues and encourage ocean stewardship. In addition, further research using qualitative data could expand our understanding of how fifth graders perceive the world of the oceans and contribute to ways that will help communicate to them the need for ocean conservation.

Finally, more money is needed for ocean research and education so that more is understood about ocean processes. Perhaps then the oceans will receive the attention and respect they deserve. This study has shown that fifth graders are willing to help protect the oceans. We can't afford to let them lose enthusiasm or interest in the oceans, as we must count on them to become tomorrow's stewards of the ocean. Therefore, ocean conservation should be an intrinsic part of environmental education, with ocean educational programs focusing on building skills that lead to ocean stewardship.

REFERENCES

Agardy, M. T. 1994. Advances in Marine Conservation: the Role of Marine Protected Areas. *Trends in Ecology and Evolution* 9, no. 7: 267-270.

Aird, A., and A. Tomera. 1977. The Effects of a Water Conservation Instructional Unit On the Values Held by Sixth Grade Students. *Journal of Environmental Education* 9: 31-42.

Allison, B. 1980. The Relationship between Child Art and Their Cultural Foundations. *Journal of Aesthetic Education* 14: 59-79.

Armstrong, J., and J. Impara. 1991. The Impact of an Environmental Education Program On Knowledge and Attitudes. *Journal of Environmental Education* 22: 36-40.

Beiswenger, R., E. L. Sturges, and R. Jones. 1992. Water Education in Wyoming: Assessing Educators' Knowledge of Water Topics and Their Use in the Elementary Curriculum. *Journal of Environmental Education* 23, no. 1: 24-29.

Birch, S. K., and K. Schwaab. 1983. The Effects of Water Conservation Instruction on Seventh-Grade Students. *Journal of Environmental Education* 14, no. 4: 26-31.

Bostford, L. W., J. C. Castilla, and C. H. Peterson. 1997. The Management of Fisheries and Marine Ecosystems. *Science* 277: 509-515.

Brody, M. J., and H. Koch. 1989. An Assessment of 4^{th}-, 8^{th}-, and 11^{th}-Grade Students' Knowledge Related to Marine Science and Natural Resource Issues. *Journal of Environmental Education* 21, no. 2: 16-26.

Brown, I. 1994. Comparing the Best of Both Worlds: Cultures through Art. *Art Education* 47: 61-67.

Brown, J. H., and J. Roughgarden. 1990. Ecology for a Changing Earth. *Bulletin of the Ecological Society of America* 71: 173-188.

Byrant, C. K., and H. R. Hungerford. 1979. An Analysis of Strategies for Teaching Environmental Concepts and Values Clarification in Kindergarten. *Journal of Environmental Education* 9, no. 1: 44-49.

Chase, V. 1990. Getting Kids Wet. *Oceanus* 33, no. 3: 21-25.

Colwell, T. 1997. The Nature-Culture Distinction and the Future of Environmental Education. *Journal of Environmental Education* 28, no. 4: 4-8.

Dayton, P. K., S. F. Thrush, M. T. Agardy, and R. J. Hofman. 1995. Viewpoint: Environmental Effects of Marine Fishing. *Aquatic Conservation: Marine And Freshwater Ecosystems* 5: 205-232.

Dresser, H. H., and J. W. Butzow. 1981. The Effects of Selected Variables on the Implementation of a Marine Education Infusion Curriculum. *School Science & Mathematics* 81, no. 6: 480-486.

Earle, Sylvia. 1995. *Sea Change: A Message of the Oceans.* New York: Ballentine Books.

Fazio, R. H., and M. P. Zanna. 1981. Direct Experience and Attitude-Behavior Consistency. *Advances in Experimental Social Psychology* 14: 161-202.

Fishbein, M., and I. Ajzen. 1975. *Belief, Attitude, Intention and Behavior: An Introduction to Theory and Research.* Reading, MA: Addison-Wesley, quoted in Musser & Malkus, "The Children's Attitudes Towards the Environment Scale," *Journal of Environmental Education* 25, (1994 no. 3): 22-26.

Fortner, R.W., and A. E. Lyon. 1985. Effects of a Cousteau Television Special on Viewer Knowledge and Attitudes. *Journal of Environmental Education* 16, no. 3: 12-20.

Fortner, R. W., and V. J. Mayer. 1983. Ohio Students' Knowledge and Attitudes about the Oceans and Great Lakes. *Ohio Journal of Science* 83, no. 5: 218-224.

Fortner, R. W., and V. J. Mayer. 1989. Marine Aquatic Education – A Challenge for Science Educators. *Science Education* 73, no. 2: 135-154.

Fortner, R.W., and V.J.Mayer. 1991. Repeated Measures of Students' Marine and Great Lakes Awareness. *Journal of Environmental Education* 23, no. 1: 30-35.

Fortner, R. W., and T. G. Teates. 1980. Baseline Studies for Marine Education: Experiences Related to Marine Knowledge and Attitudes. *Journal of Environmental Education* 11, no. 4: 11-19.

Fox, W. 1995. Education, the Interpretive Agenda of Science, and the Obligation of Scientists to Promote this Agenda. *Environmental Values* 4, no. 1: 109-114.

Frankel, E. 1995. *Ocean Environmental Management: A Primer on the Role of the Oceans and How to Maintain Their Contributions to Life on Earth.* Englewood Cliffs, New Jersey: Prentice Hall.

George, R. and D. Kaplan. 1998. A Structural Model of Parent and Teacher Influences on Science Attitudes of Eighth Graders: Evidence from NELS: 88. *Science Education* 82, no. 1: 93-109.

Gifford, R., R. Hay, and K. Boros. 1982. Individual Difference in Environmental Attitudes. *Journal of Environmental Education* 14, no. 2: 19-23.

Goldberg, E. D. 1997. Plasticizing the Seafloor: An Overview. *Environmental Technology* 18: 195-202.

Goodwin, H. L. 1978. *A Statement on the Need for Marine & Aquatic Education to Inform Americans about the World of Water.* Delaware-University, Newark: Collection of Marine Studies. ERIC ED 156541.

Gustaitis, R., and R. McGrath. 1992. Who Will Mind Our Riches? *Coast & Ocean* 8, no. 2: 16-34.

Hagler, M. 1995. Deforestation of the Deep: Fishing and the State of the Oceans. *The Ecologist* 25, no. 2-3:74-79.

Hausbech, K. W., L. W. Milbrath and S. M. Enright. 1992. Environmental Knowledge, Awareness, and Concern Among 11th- Grade Students: New York State. *Journal of Environmental Education* 24: 27-34.

Hines, J. M., H. R. Hungerford, and A. N. Tomera. 1986. Analysis and Synthesis of Research on Responsible Environmental Behavior: A Meta-Analysis. *Journal of Environmental Education* 18, no. 2: 1-8.

Howe R. W., and C. L. Price. 1976. *Survey of Students' Knowledge and Attitudes Regarding Oceanic Education.* Unpublished survey, Ohio State University. quoted in Fortner & Teates, "Baseline Studies for Marine Education: Experiences Related to Marine Knowledge and Attitudes," *Journal of Environmental Education* 11, (1980 no. 4): 11-19.

Huberty, C. J., and G. A. Klein. 1996. On Evaluating the Impact of an Innovative Educational Project. *Journal of Research and Development in Education* 29, no. 2: 89-93.

Hungerford, H. R. and T. L. Volk. 1990. Changing Learner Behavior Through Environmental Education. *Journal of Environmental Education* 21, no. 3: 8-21.

Jacobius, R. 1977. Why Oceanic Education? *Environmental Education Report* 5: 2.

Joint Committee on Standards for Educational Evaluations. 1981. *Standards for Evaluations of Educational Programs, Projects, and Materials.* New York: McGraw Hill.

Klee, G. A. 1999. *The Coastal Environment: Toward Integrated Coastal and Marine Sanctuary Management.* Upper Saddle River, New Jersey: Prentice Hall.

Korpan, C., G. Bisanz, J. Bisanz, C. Boehme, and M. Lynch. 1997. What Did You Learn Outside of School Today? Using Structured Interviews to Document Home and Community Activities Related to Science and Technology. *Science Education* 81, no. 6: 651-662.

Lark- Horovitz, B., H. Lewis, and M. Luca. 1967. *Understanding Children's Art for Better Teaching.* Columbus, OH: Charles E. Merrill Books, Inc.

Le Doux-Bloom, C. 1995. Marine Science Curriculum Developed for Bilingual Learners. Master's thesis, San José State University.

Lemming, F. C., W. Dwyer, B. Porter, and M. Cobern. 1993. Outcome Research in Environmental Education: A Critical Review. *Journal of Environmental Education* 24, no. 4: 8-21.

Lemming, F. C., W. O. Dwyer, and B. A. Bracken. 1995. Children's Environmental Attitude and Knowledge Scale: Construction and Validation. *Journal of Environmental Education* 26, no. 3: 22-31.

Lucas, A. M. 1980. The Role of Science Education in Education for the Environment. *Journal of Environmental Education* 12, no. 2: 33-37.

Mack, A. 1993. Security Regimes for the Oceans: The Tragedy of the Commons, The Security Dilemma, and Common Security. In *Freedom for the Seas in the 21st Century*, ed. J. M. Dyke, D. Zaelke, and G. Hewison, 409-419. Washington D.C.: Island Press.

Maloney, M. P., and G. N. Braucht. 1975. A Revised Scale for the Measurement of Ecological Attitudes and Knowledge. *American Psychologist* 30: 787-790, quoted in Lemming, F. C. et al., "Children's Environmental Attitude and Knowledge Scale: Construction and Validation," *Journal of Environmental Education* 24, (1995 no. 3): 22-31.

McIntyre, A.D. 1992. Introduction: a Perspective on Marine Conservation. *Proceedings of the Royal Society of Edinburgh* 100B: 1-2.

Menduno, M. 1998. Exploring the Ocean Planet. *Scientific American* 9, no. 3: 106-112.

Milliman, J. D. 1996. Integrating Research and Education with Public Outreach at Coastal Laboratories. *Biological Bulletin* 190, no. 2: 278-285.

Morrell, P. 1998. Students' Attitudes Toward School and Classroom Science: Are They Independent Phenomena? *School Science and Mathematics* 98, no. 2:76-83.

Musser, L., and A. Malkus. 1994. The Children's Attitudes Toward the Environment Scale. *Journal of Environmental Education* 25, no. 3: 22-26.

National Oceanic and Atmospheric Administration (NOAA). 1998. *Year of the Ocean Discussion Papers*. Washington, D.C.: NOAA Office of the Chief Scientist.

Niebuhr, D. H. 1998. Education, Outreach, and Public Relations in Coastal Resource Management and Science: Is Earth Day Enough? *The Coastal Society Bulletin* 20, no. 2: 10-13.

Nixon, S.W. 1998. Enriching the Sea to Death. *Scientific American* 9, no. 3: 48-53.

Norse, E., ed. 1993. *Global Marine Biological Diversity.* Washington D.C.: Island Press.

Norse, E., 1995. Maintaining the World's Marine Biological Diversity. *Bulletin of Marine Science* 57, no. 1: 10-13.

North American Association for Environmental Education (NAAEE). 1996. *Environmental Education Materials: Guidelines for Excellence.* Troy, OH: NAAEE Publications and Membership Office.

Ozawa, C. P. 1996. Science in Environmental Conflicts. *Sociological Perspectives* 39, no. 2: 219-230.

Papageorgiou, G., K. Ouzounis, G. Papadakis, N. Samaras, and G. Tripsianir. 1996. Environmental Education at the Primary Level: A Study of It's Application in Northeast Greece. *Environmental Education & Information* 15: 331-338.

Raloff, J. 1998. *Picturing Pesticide's Impacts on Kids.* Science News 153: 358.

Ray, C. 1964. Inshore Marine Conservation. In *First World Conference on National Parks held in Seattle 30 June - 7 July 1962,* ed. A. B. Adams, 77-87. Washington D.C.: ICUN Publications.

Regan, D. T., and R. H. Fazio. 1977. On the Consistency Between Attitudes and Behavior: Look to the Method of Attitude Formation. *Journal of Experimental Social Psychology* 13: 38-45.

Roth, R. E., and J. Perez. 1992. Twelfth Grade Student Knowledge and Attitudes Toward the Environment in the Dominican Republic: An Assessment. *Journal of Environmental Education* 20, no. 3:10-14.

Rubenstein, J. 1987. A Cross-Cultural Comparison of Children's Drawings of Same- and Mixed-Sex Peer Interaction. *Journal of Cross-Cultural Psychology* 18: 234-50.

Ryan, C. 1991. The Effect of a Conservation Program on School Children's Attitudes toward the Environment. *Journal of Environmental Education* 22: 30-35.

Safina, Carl. 1995. The World's Imperiled Fish. *Scientific American* 273, no. 5: 46-53.

Safina, Carl. 1998. *Song for the Blue Ocean: Encounters Along the World's Coasts and Beneath the Seas.* New York: Henry Holt and Company, Inc.

SeaWeb, 1996. *National Public Opinion Poll Results,* Mellman Group, Washington, D.C., 35pp.

Thompson, S .G., and M. A. Barton. 1994. Egocentric and Anthropocentric Attitudes Toward the Environment. *Journal of Environmental Psychology* 14, no. 2: 149-157.

Thorndike, R. L. 1982. *Applied Psychometrics.* Boston: Houghton Mifflin Company.

UNESCO-UNEP. 1976. The Belgrade Charter. *Connect: UNESCO-UNEP Environmental Newsletter* 1, no. 1: 1-2, quoted in *North American Association for Environmental Education Materials: Guidelines for Excellence.* Troy, OH: NAAEE Publications and Membership Office, 1996 .

Webster, P. J., and J. A. Curry. 1998. The Oceans and Weather. *Scientific American* 9, no. 3: 38-43.

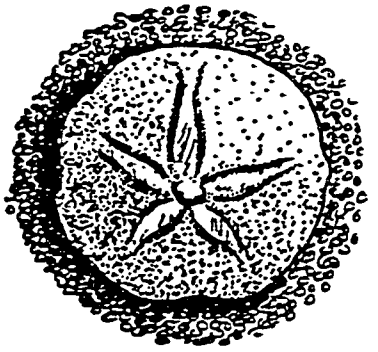
Weilbacher, M. 1994. The Single Most Important Thing to Know About the Earth. *Clearing* 85: 3-4, 38.

Zimmerman, E. 1994. How Should Students' Progress and Achievements in Art Be Assessed? A Case for Assessment that is Responsive to Diverse Students' Needs. *Visual Arts Research* 20, no. 1: 29-35.

APPENDIX A.

Student Survey, Teacher Questionnaire, and Recruitment Letter

Ocean Survey for Fifth Graders



How much do you know about the oceans? This is not a real test where you will get a grade on your answers. We want to know how much 5th graders know about the oceans. By answering this survey, you will be helping us with a research project. This first section has questions about general information relating to the ocean. Pick ONE letter for each question that you think is the best answer.

1. I am a
   a. girl
   b. boy

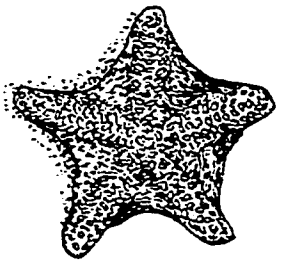
2. I am _____years old.
   a. 8 b. 9 c.10 d. 11 e.12

3. The world's oceans are so big.....
   a. we can never run out of fish to eat.
   b. that sealife won't be affected if we dump toxic waste on the seafloor.
   c. but, they might run out of fish if we don't treat them carefully.

4. MOST ocean pollution occurs because
   a. it grows there.
   b. it runs off the land from rivers and when it rains.
   c. ships accidentally dump oil into the ocean.

5. "Marine Conservation" means
   a. to not use so much water.
   b. to believe the oceans should not be used for fishing.
   c. to collect shells and other ocean related objects.
   d. to keep the oceans a healthy place for fish and plants to live.

6. It's best if fisherman
   a. only catch the baby fish and keep bigger fish in the ocean.
   b. try to keep enough fish in the ocean so there will be plenty for the future.
   c. are left alone to catch as many fish as they want every year.



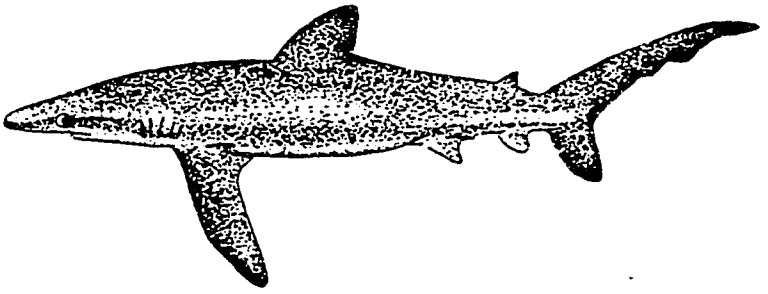
7. Oceans are important
   a. as a food source.
   b. for medicine from certain animals and plants found in the ocean.
   c. in regulating world weather.
   d. all of the above.

8. "Stewardship of the oceans" means
   a. to take care of the oceans.
   b. fishing is good for the oceans.
   c. the Coast Guard, a group who protects the oceans for us.
   d. ships that clean the ocean.

9. The method of farm-raised fish (aquaculture)
   a. can not be done.
   b. produces fish that is not as tasty as wild grown fish.
   c. is a good solution to overfishing, though sometimes causes harm to the environment.
   d. is a waste of time and money.

10. It is okay to kill sharks in the ocean because
    a. it will make the oceans safer for other fish.
    b. it will not have any effect on the oceans.
    c. it is not okay - because they are at the top of the food chain, they are an important part of the ocean.

11. Coral reefs have as many different kinds of plants and animals as
    a. deserts.
    b. tropical rain forests.
    c. redwood forests.
    d. lakes.



12. People can harm the oceans by
    a. overfishing.
    b. polluting.
    c. destroying fish habitat.
    d. a combination of all of the above.

The following questions are about how you feel about the ocean. Pick the one answer that describes most how YOU feel.

13. I should take care of the oceans
    a. but there is nothing I can personally do.
    b. because it's my responsibility to respect the environment.
    c. but I don't use the oceans, so it's not my responsibility.
    d. but I don't need to - the oceans are so big, it's impossible to harm them.

14. When I think of a shark,
    a. I get scared.
    b. it reminds me of a ferocious killer.
    c. it makes me sad that so many sharks are caught just for their fins.
    d. I want to protect it from being overfished.

15. Buying "dolphin safe" tuna is a good thing because
    a. it's usually the cheapest tuna.
    b. it saves dolphins' lives when the fisherman catch the tuna in the ocean.
    c. it's always good to buy products that help save the oceans.
    d. it tastes better than the other kind of tuna.

16. If I had to use part of my allowance to pay an "entrance fee" to play at the seashore,
    a. I'd rather play somewhere else.
    b. I'd be willing to pay only if I could take home souvenirs like sand and shells.
    c. I'd be willing to pay if it meant there were fewer people at the seashore.
    d. I'd be willing to pay if it meant I would be helping the oceans stay healthy.

17. I think that if the world's population keeps growing,
    a. it won't hurt the oceans at all.
    b. there won't be enough fish for everyone in the world to eat.
    c. there will still be plenty of room for everyone to live by the ocean.
    d. too many people will add too much pollution to the ocean.
    e. both "b" and "d".

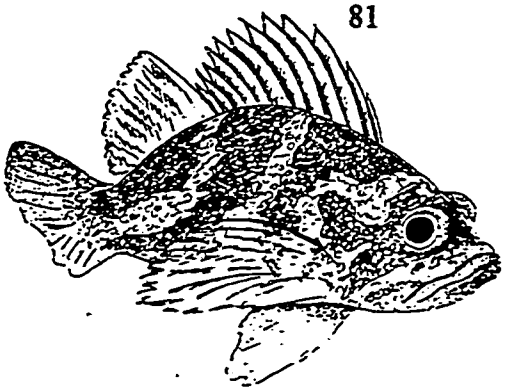
18. I would help in a beach clean-up
    a. only if I had to for school.
    b. because I would be doing something to help the oceans.
    c. because it would make me feel good about the environment.
    d. this is something I would not want to do.

The following questions relate to you. Pick the <u>ONE</u> answer that describes <u>you</u> best.

19. I have been to an aquarium
    a. never
    b. 1-5 times
    c. more than 5 times

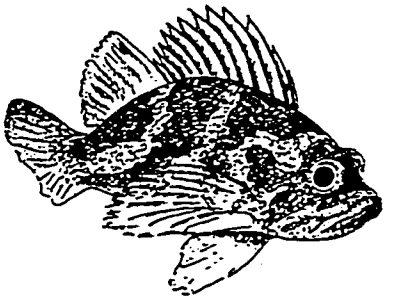
20. When I go to an aquarium, my <u>favorite</u> part is
    a. to see all the animals that live in the ocean.
    b. to see what ocean habitats look like.
    c. learning what I can do to protect the oceans.
    d. I have never been to an aquarium.

21. I have been to the ocean
    a. never
    b. 1-5 times
    c. 6-10 times
    d. more than 10 times



22. I have been on a boat (on the ocean, lake, or river)
    a. never
    b. once
    c. 2-5 times
    d. more than 5 times.

23. I have seen ocean nature films on television
    a. Never
    b. Once a month or less
    c. 2-3 times a month
    d. About once a week
    e. More than once a week



24. I read books on oceans and marine animals
    a. Never
    b. Once a month
    c. 2-3 times a month
    d. About once a week
    e. More than once a week

25. I have studied something about the oceans at school
    a. Yes
    b. No

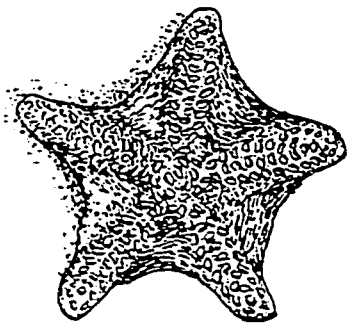
For each of the following questions, pick the letters that describe you.
<u>Choose as many answers that apply to you</u>.

26. I search the (computer) Internet
    a. for help with my school work.
    b. to look for information about sports, music, movies and other entertainment.
    c. to learn about the ocean or other nature issues.
    d. I never use the Internet.

27. A good reason to protect the ocean is because
    a. it's beautiful.
    b. it provides food.
    c. it's good for the health of the planet.
    d. I like to swim in unpolluted water.
    e. marine animals and plants may provide the cure for cancer and other diseases.

28. I like to eat fish
    a. because it's good for me.
    b. because it tastes good.
    c. only if I know that it's not a type of fish that is becoming endangered.
    d. but I'm afraid it's bad for me because of polluted waters.
    e. only if I have to, I don't really like the taste.

29. I would like to live by the ocean when I grow up
    a. because I live by the ocean now and I like it.
    b. because I love to visit the ocean and would like to spend more time there.
    c. because I want a job relating to the oceans.
    d. because my family lives there.
    e. it's not important to me if I live by the ocean.



30. I like to
    a. swim in a pool.
    b. swim in the ocean.
    c. snorkel, or would like to learn to scuba dive.
    d. I don't know how to swim, but would like to learn.
    f. I don't like to swim.

31. A good way that I can help protect the oceans is
    a. to learn more about it.
    b. to save my allowance and donate to groups that protect the oceans.
    c. to write letters to my Congressman about protecting the oceans.
    d. to become a marine biologist.
    e. to help with beach clean-ups.

32. List some words, or a sentence that describe how you feel about the oceans.

33. What interests you about the oceans that you would like to learn more about?

34. In the space below, draw a picture of what the oceans mean to you.

Teacher Questionnaire for 5th Grade Marine Conservation Survey

Name_____

School_____

Number of total students at your school_____**In your class**_____

Approximate (average) income of student household_____

1. How long have you been a certified teacher?

2. Have you in the past, or do you currently teach fifth grade? If so, how long? What grade do you teach presently?

3. Have you taught fifth graders about the ocean ecosystems?

4. If yes to # 3, have you incorporated environmental education or conservation values into the curriculum? Please give examples.

5. Have you taken your students on a field trip to the ocean? If yes, what activities did you do there with your class?

6. Have you taken your students on a field trip to a river or wetland area? If yes, what activities did you do there with your class?

7. Have you taken your students on a field trip to an aquarium? If yes, which aquarium?

8. Where do you think your students get most of their information about ocean related topics?

9. What topics are not included that would like to see in the student survey?

10. What topics included in the student survey do you feel are not appropriate for fifth graders?

I'd like to take part in the Marine Conservation Survey by having you administer the survey to my students.

Why or why not_____

The following dates in November would be acceptable for testing

_____

I can be reached at: Phone (work)_____ (home)_____

Name_____ School name_____

Mailing address_____

e-mail_____

For further comments and questions, please contact Susan Giles at 831-643-1525 or on e-mail at giles@mbay.net

Please return questionnaire in return envelope. I look forward to working with you and your students in the near future.

San José State
UNIVERSITY

Department of Environmental Studies
One Washington Square
San José, CA 95192-0115
Voice: 408-924-5450
Fax: 408-924-5477

October, 1998

Dear Teacher,

I am a graduate student at San José State University, working on my Masters Degree in Environmental Studies, concentrating in marine conservation. As part of my Master's thesis, I have developed a survey for fifth graders, to conduct a baseline study of what fifth graders already know and how they feel about protecting the oceans.

I will be conducting the marine conservation survey in November, and would greatly appreciate your help. I would like to administer my survey to your fifth grade students. The survey takes approximately 20 minutes to complete, and would be done in normal school hours in your presence. As a thank you for your participation, the Monterey Bay Aquarium will be donating a natural history book to your class.

I have been a Monterey Bay Aquarium volunteer for the past 2 years and I am now working with their Education Department on my research. The Monterey Bay Aquarium is currently developing a curriculum for fifth grade students based on marine conservation. My research is geared at supplementing the evaluation process of this curriculum by providing a baseline study of marine knowledge and attitudes of fifth graders. The goal of my research is to gather information for the purpose of further development of marine conservation education.

I will be comparing knowledge and attitudes of students who live in 3 locations to examine if location has any affect on knowledge and attitudes. Specifically, I will be testing students who live along coastal California, inland California (Fresno area), and students living in Denver, Colorado. With coastal populations rapidly increasing, it is essential that everyone is educated equally on marine conservation issues. Healthy oceans are necessary for the health of the planet, and it is important to know the best ways to communicate key messages of ocean protection. Knowing what knowledge and attitudes exist in the population is a first step to achieving that goal. In addition, my study will possibly serve as the beginning of a longitudinal study to look at the changes in fifth grade knowledge and attitudes about ocean related issues over time.

After a career in New York City in advertising, and then as a scuba instructor in the Caribbean, I am now focusing my work on public education and awareness of marine conservation issues.

I am enclosing the student survey and a questionnaire for you to answer. Please return the questionnaire to me in the return envelope. Please indicate appropriate times for me to administer the survey to your students. I will then contact you to confirm date and time. I welcome your comments, and look forward to working with you and your students in the near future.

Thanking you in advance,

APPENDIX B.

Human Subjects Letter, and Parent Consent Form

San José State
UNIVERSITY

Office of the Academic Vice President
Associate Vice President Graduate Studies and Research
One Washington Square
San José, CA 95192-0025
Voice: 408-924-2480
Fax: 408-924-2477
E-mail: gstudies@wahoo.sjsu.edu
http://www.sjsu.edu

TO: Susan Giles
P.O. Box JE
Pacific Grove, CA 93950

FROM: Serena W. Stanford
AVP, Graduate Studies & Research

DATE: September 17, 1998

The Human Subjects-Institutional Review Board has approved your request to use human subjects in the study entitled:

"Marine Conservation: A Baseline Study of the Knowledge and Attitudes of Fifth Graders"

This approval is contingent upon the subjects participating in your research project being appropriately protected from risk. This includes the protection of the anonymity of the subjects' identity when they participate in your research project, and with regard to any and all data that may be collected from the subjects. The Board's approval includes continued monitoring of your research by the Board to assure that the subjects are being adequately and properly protected from such risks. If at any time a subject becomes injured or complains of injury, you must notify Serena Stanford, Ph.D., immediately. Injury includes but is not limited to bodily harm, psychological trauma and release of potentially damaging personal information.

Please also be advised that all subjects need to be fully informed and aware that their participation in your research project is voluntary, and that he or she may withdraw from the project at any time. Further, a subject's participation, refusal to participate, or withdrawal will not affect any services the subject is receiving or will receive at the institution in which the research is being conducted.

If you have any questions, please contact me at (408) 924-2480.

San José State
UNIVERSITY

Department of
Environmental Studies
One Washington Square
San Jose, CA 95192-0115
Voice 408-924-5450
Fax: 408-924-5477

Agreement to Participate in Research

Responsible Investigator: **Susan Giles**

Title of Protocol: "Marine Conservation: A Baseline Study of Knowledge and Attitudes of Fifth Graders."

My child or ward has been asked to participate in a research study investigating the knowledge and attitudes of fifth graders concerning marine conservation. My child or ward will be asked to answer a multiple-choice, written survey administered in the child's classroom during regular school hours. The survey will be administered in the presence of the child's teacher, and the above investigator.

No risks are anticipated to occur with the administration of this survey. The results of this study will help in the development of educational material focusing on marine conservation awareness. The results of this study will be part of a Master's thesis with San José State University and may be published. No information that could identify individual subjects will be included in any written, published material.

Questions about the research may be addressed to Susan Giles at 831-643-1525. Complaints about the research may be presented to Lester Rowntree, Chairman, Department of Environmental Studies, at 408-924-5450. Questions or complaints about research, subjects' rights, or research-related injury may be presented to Serena Stanford, Ph.D., Associate Academic Vice President for Graduate Studies and Research, at 408-924-2480.

Your child can choose to "not participate" in this study, with no penalty of any kind. Consent to participate in this study is voluntary. A subject may refuse to participate in this study or in any part of this study. If a subject decides to participate in the study, he or she is free to withdraw at any time without prejudice to the subject's relations with San José State University or any other participating institutions.

Name of Child or Ward	Parent or Guardian's Signature	Date
Relation to Child or Ward		Phone
Full Mailing Address		
Investigator's Signature		Date

The signature of a parent or guardian on this document indicates approval for the child or ward to participate in the study and a statement that the child or ward is freely willing to participate. A copy of the signed and dated consent form will be on file at the participating institution.

APPENDIX C.

Knowledge, Attitude, and Multiple Response Results

Results of Knowledge Questions (percent correct), by location.

	Coastal California	Inland California	Denver, Colorado
BIG	85.3%	74.2%	82.8%
POLUTN	24.2%	17.2%	21.4%
CONSERV	90.0%	83.9%	85.5%
FISHMEN	90.0%	84.9%	86.2%
IMPORT	66.8%	58.1%	64.1%
STEWARD	43.7%	58.1%	44.1%
AQUACULT	57.9%	61.3%	70.3%
SHARKS	84.7%	84.9%	84.8%
REEFS	62.6%	65.6%	69.0%
HARM	70.5%	68.8%	67.6%

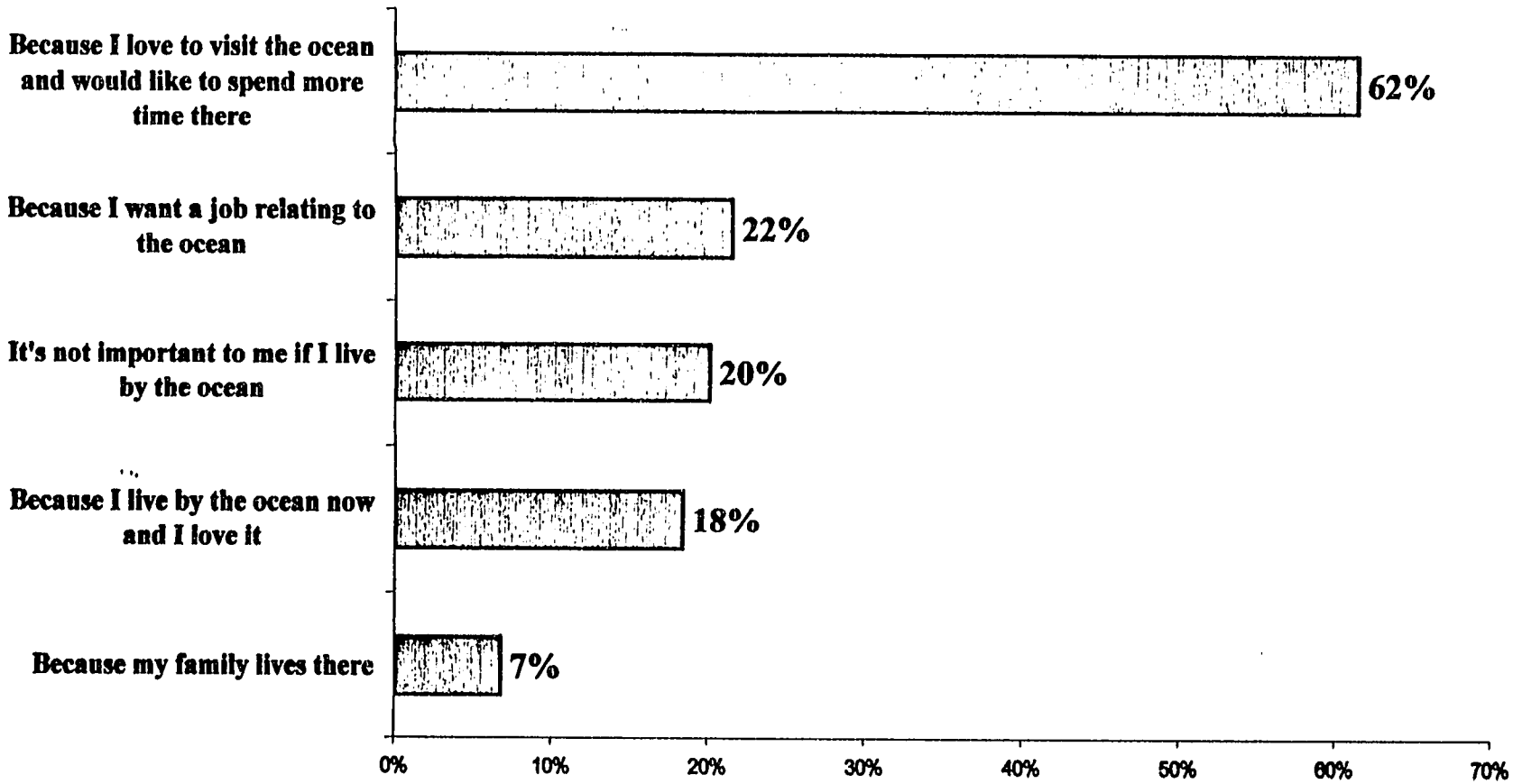
BIG	The world's oceans are so big....
POLUTN	MOST ocean pollution occurs because....
CONSERV	"Marine conservation" means....
FISHMEN	It's best if fishermen....
IMPORT	Oceans are important...
STEWARD	"Stewardship of the oceans" means...
AQUACULT	The method of farm-raised fish (aquaculture)...
SHARKS	It's okay to kill sharks in the ocean because...
REEFS	Coral reefs have as many different kinds of plants and animals as...
HARM	People can harm the oceans by...

Results of Attitude Questions (percent positive), by location.

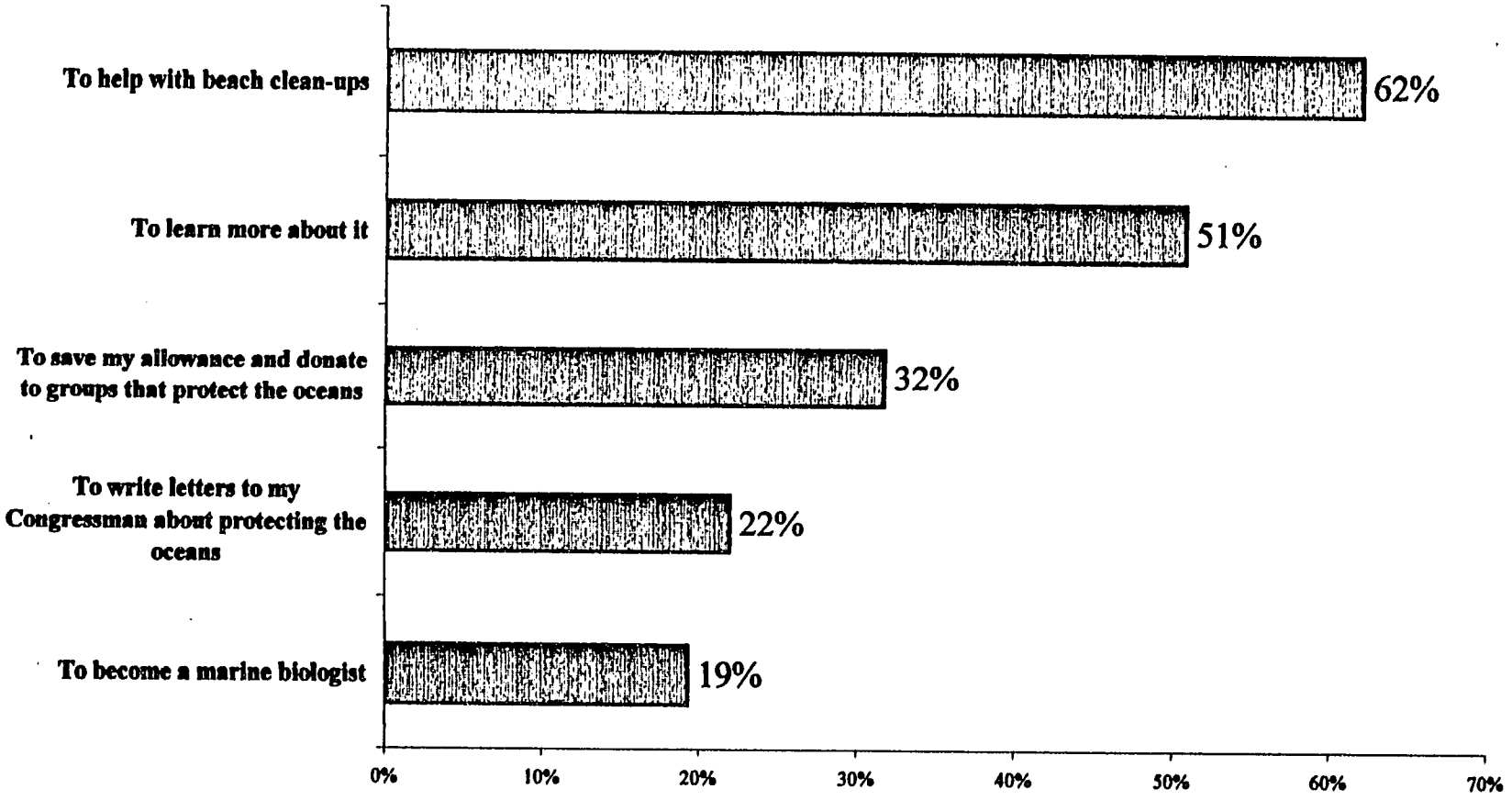
	Coastal California	Inland California	Denver, Colorado
CARE			
(a) 2pts	11.7%	18.3%	20.0%
(b) 3pts	83.9%	69.9%	69.7%
(c) 1pt	1.1%	5.4%	3.4%
(d) 1pt	2.2%	6.5%	6.2%
THKSHRK			
(a) 1pt	13.3%	20.4%	9.7%
(b) 1pt	15.0%	25.8%	18.6%
(c) 2pts	36.7%	31.2%	46.2%
(d) 3pts	32.8%	22.6%	24.8%
DOLPHIN			
(a) 1pt	7.2%	9.7%	2.1%
(b) 2pts	40.6%	41.9%	47.6%
(c) 3pts	46.1%	45.2%	48.3%
(d) 1pt	3.9%	3.2%	2.1%
FEE			
(a) 1pt	10.0%	10.8%	9.7%
(b) 2pts	6.1%	12.9%	9.0%
(c) 2pts	2.8%	4.3%	4.8%
(d) 3pts	77.2%	71.0%	75.9%
POPUL			
(a) 1pt	3.9%	6.5%	5.5%
(b) 2pts	2.8%	4.3%	4.8%
(c) 1pt	5.6%	4.3%	4.8%
(d) 2pts	25.6%	22.6%	32.4%
(e) 3pts	56.7%	62.4%	50.3%
BEACH			
(a) 1pt	5.0%	10.8%	9.7%
(b) 3pts	66.1%	60.2%	62.1%
(c) 2pts	23.3%	26.9%	24.1%
(d) 1pt	3.3%	2.2%	3.4%

CARE	I should take care of the oceans....
THKSHRK	When I think of a shark...
DOLPHIN	Buying dolphin-safe tuna is a good thing...
FEE	If I had to use part of my allowance to pay an "entrance fee" to play at the seashore...
POPUL	I think that if the world's population keeps growing...
BEACH	I would help in a beach clean up...

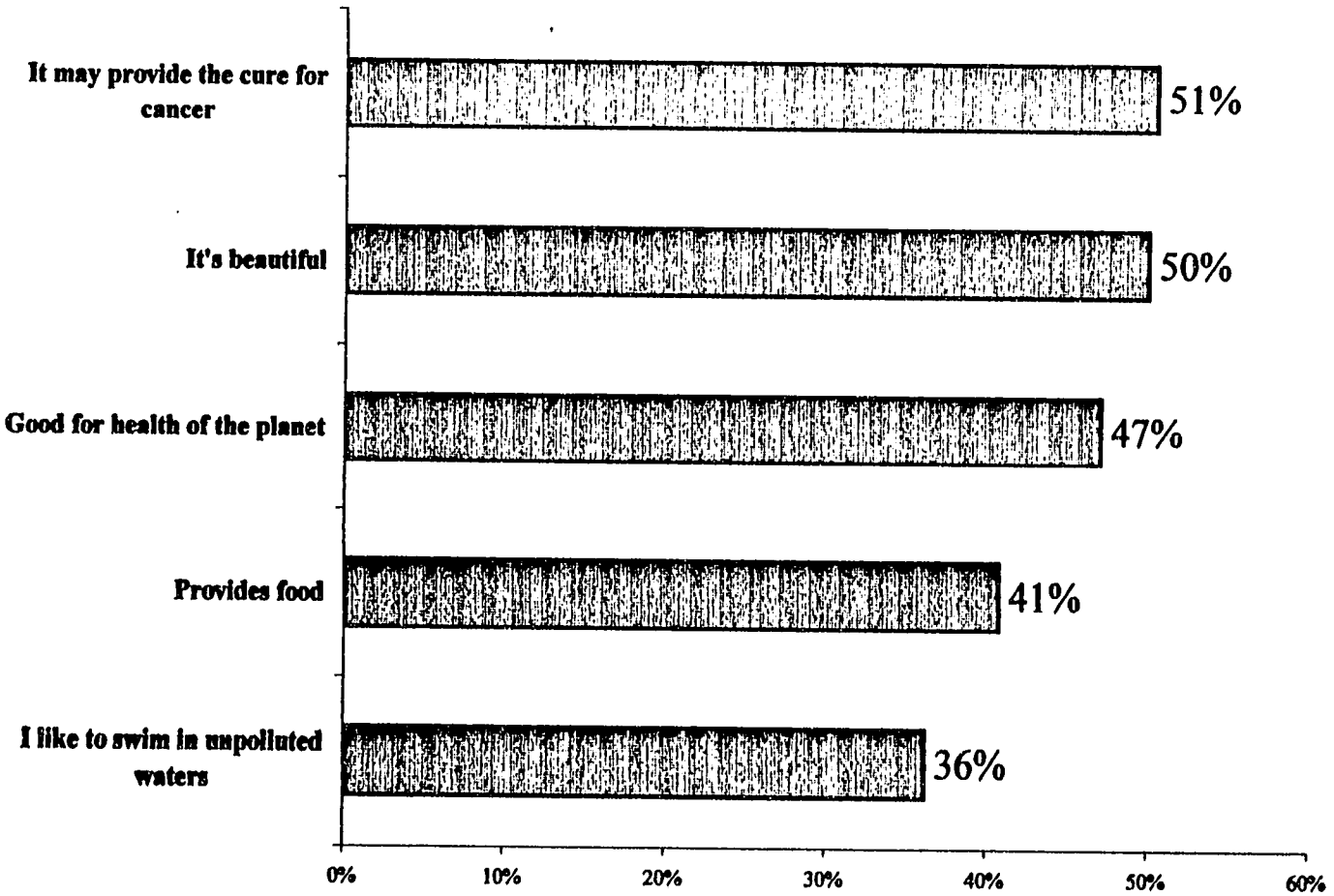
Responses to, "I would like to live by the ocean when I grow up..."



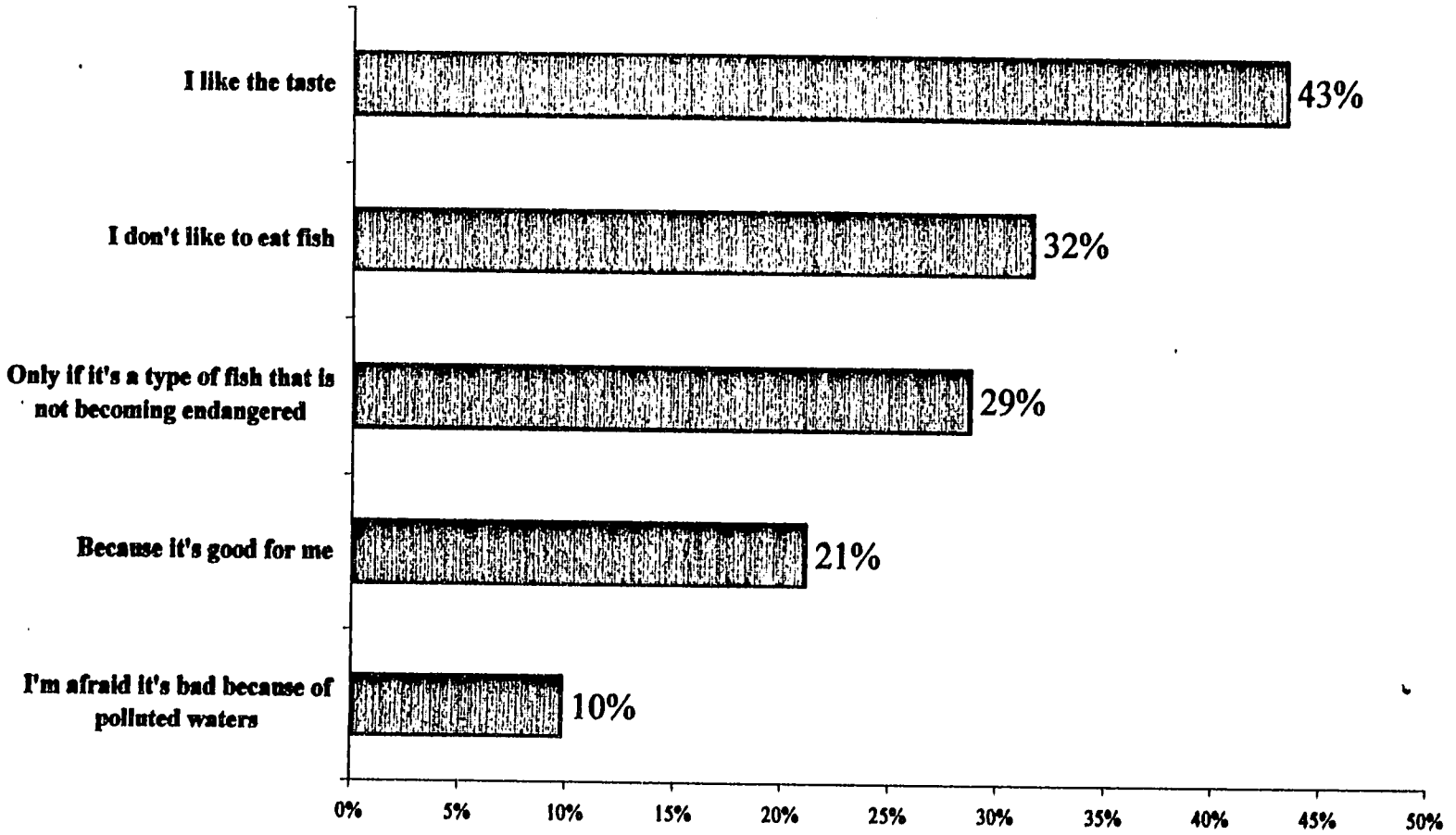
Responses to, " A good way that I can protect the ocean is..."



Responses to, "A good reason to protect the ocean is because..."



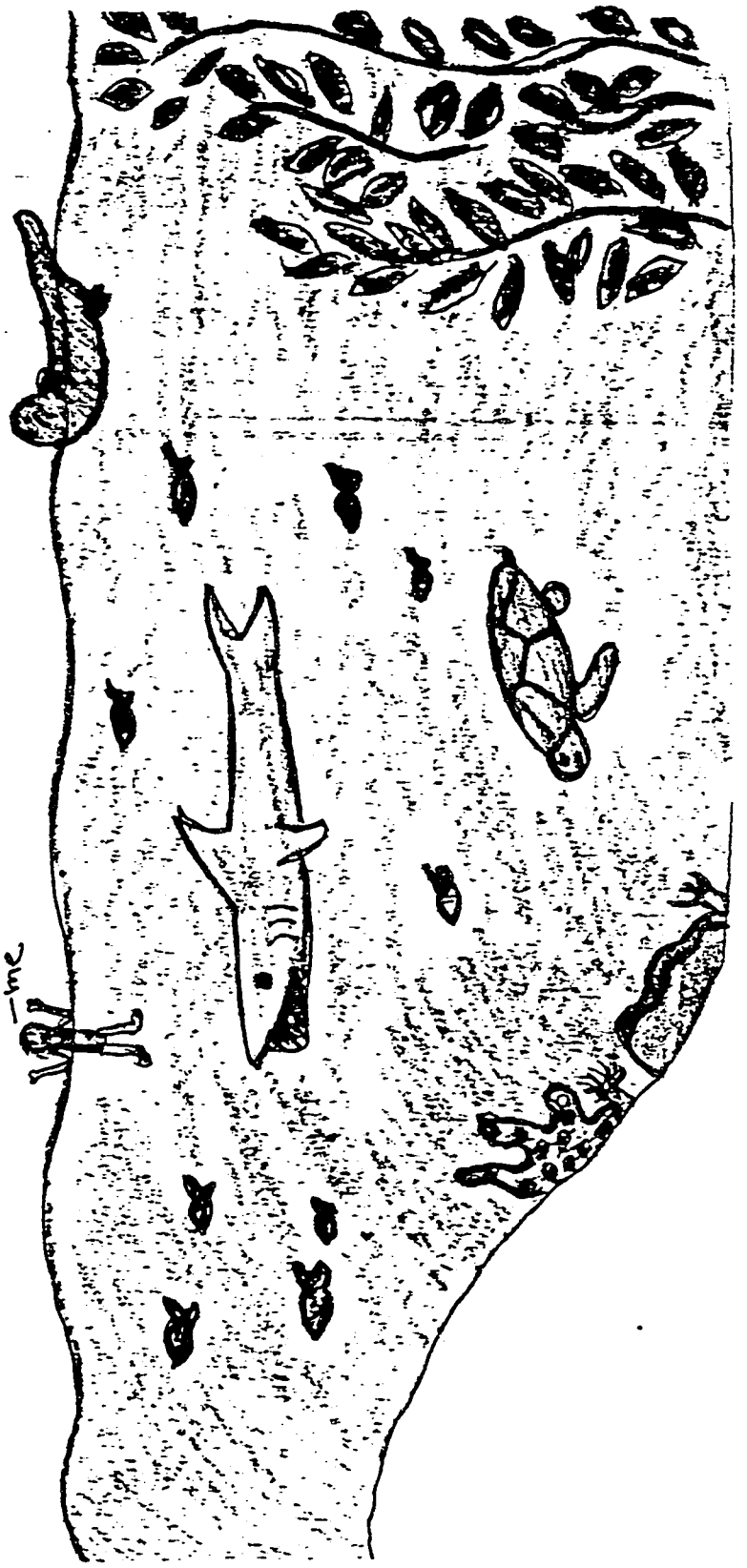
Responses to, " I like to eat fish..."



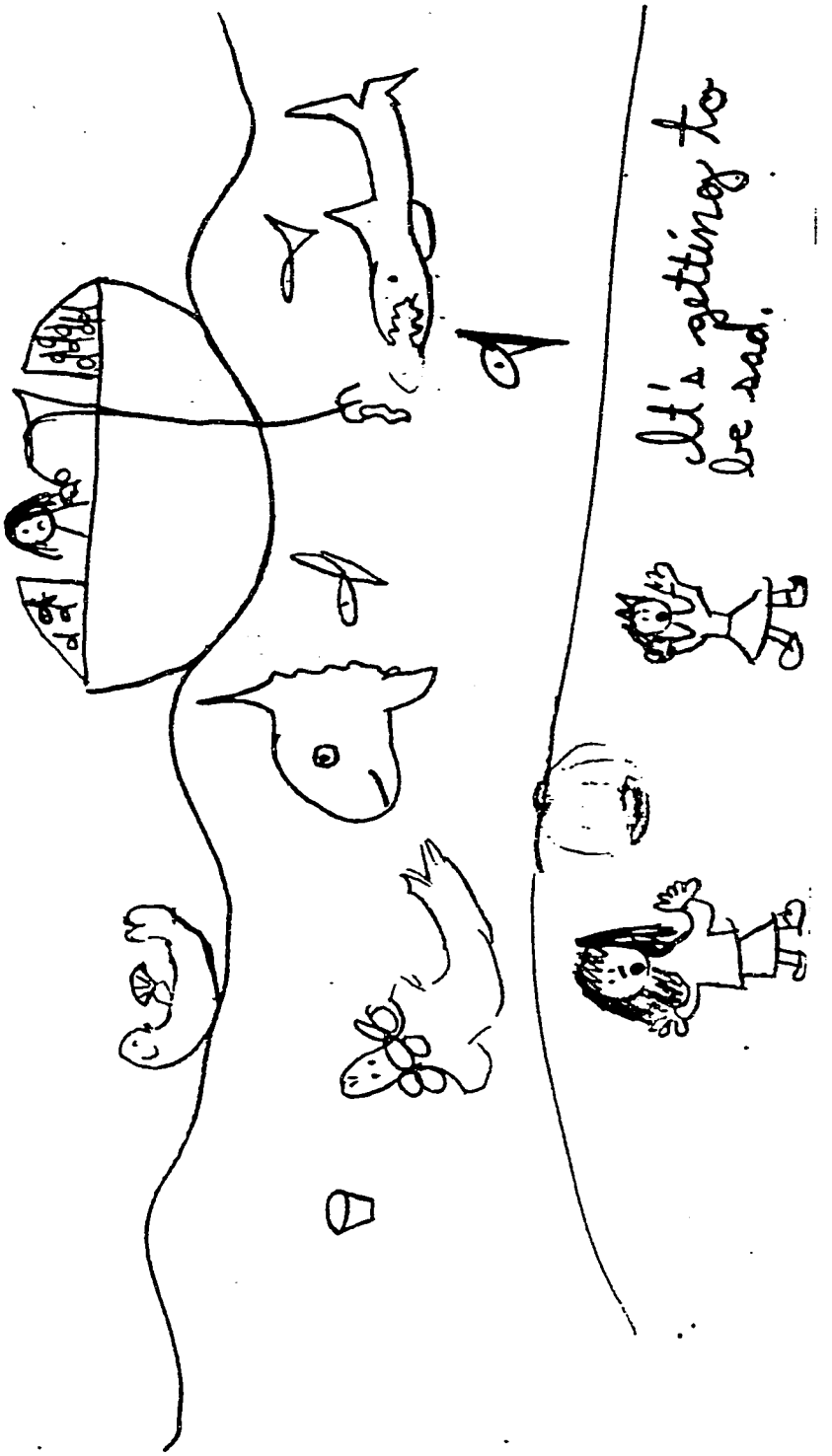
APPENDIX D.

Sample Art

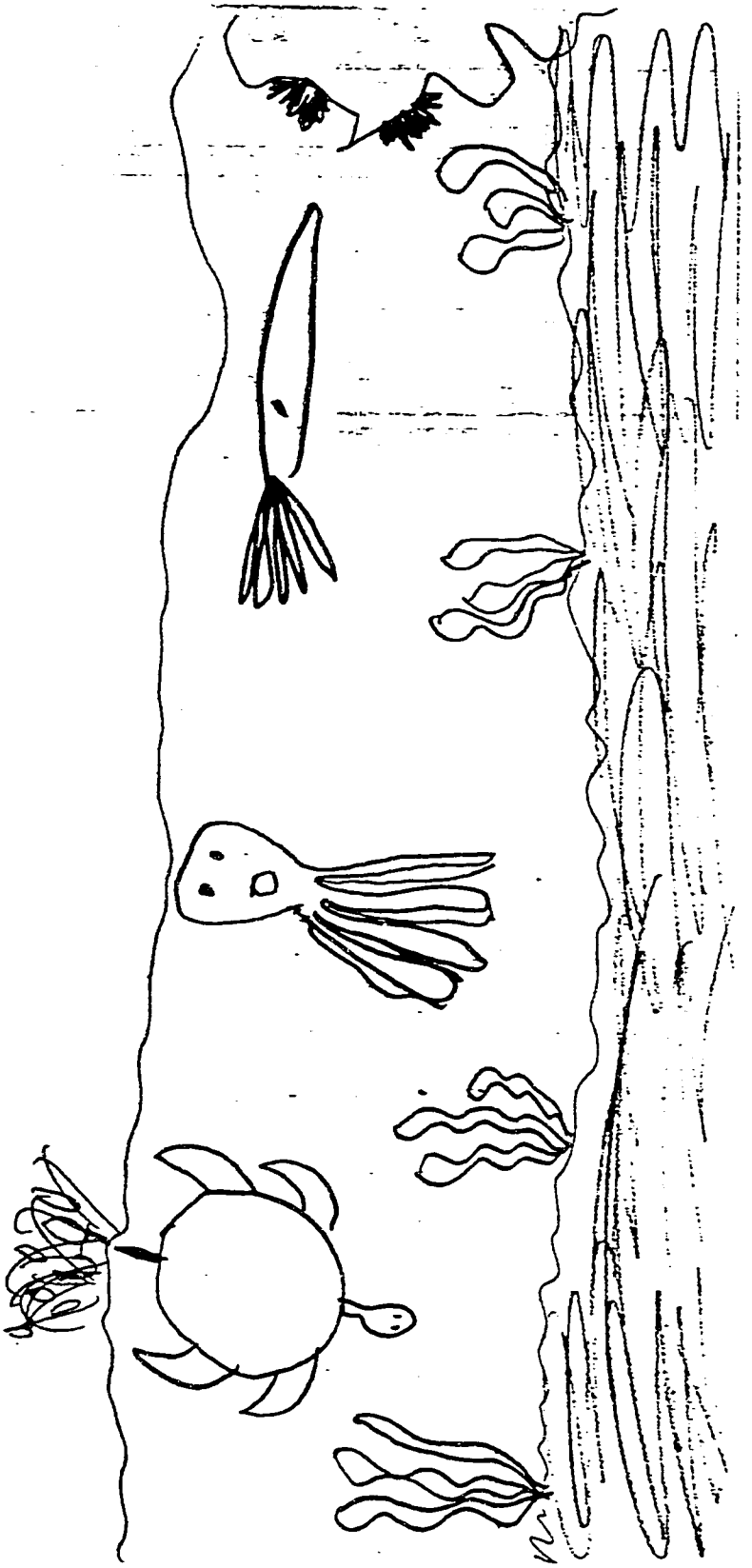
Drawing by ten-year old girl from coastal California study area.



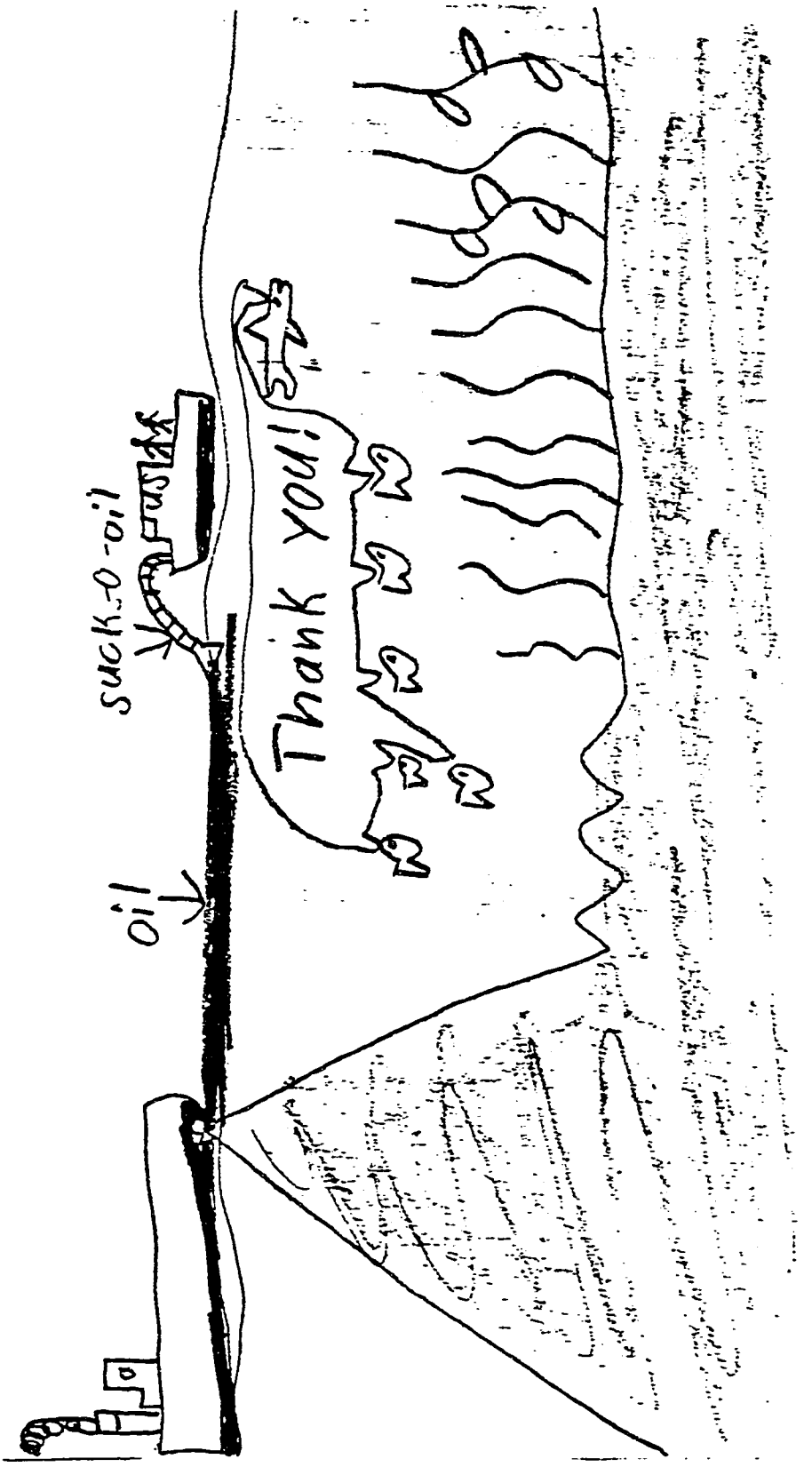
Drawing by ten-year old girl from coastal California study area.



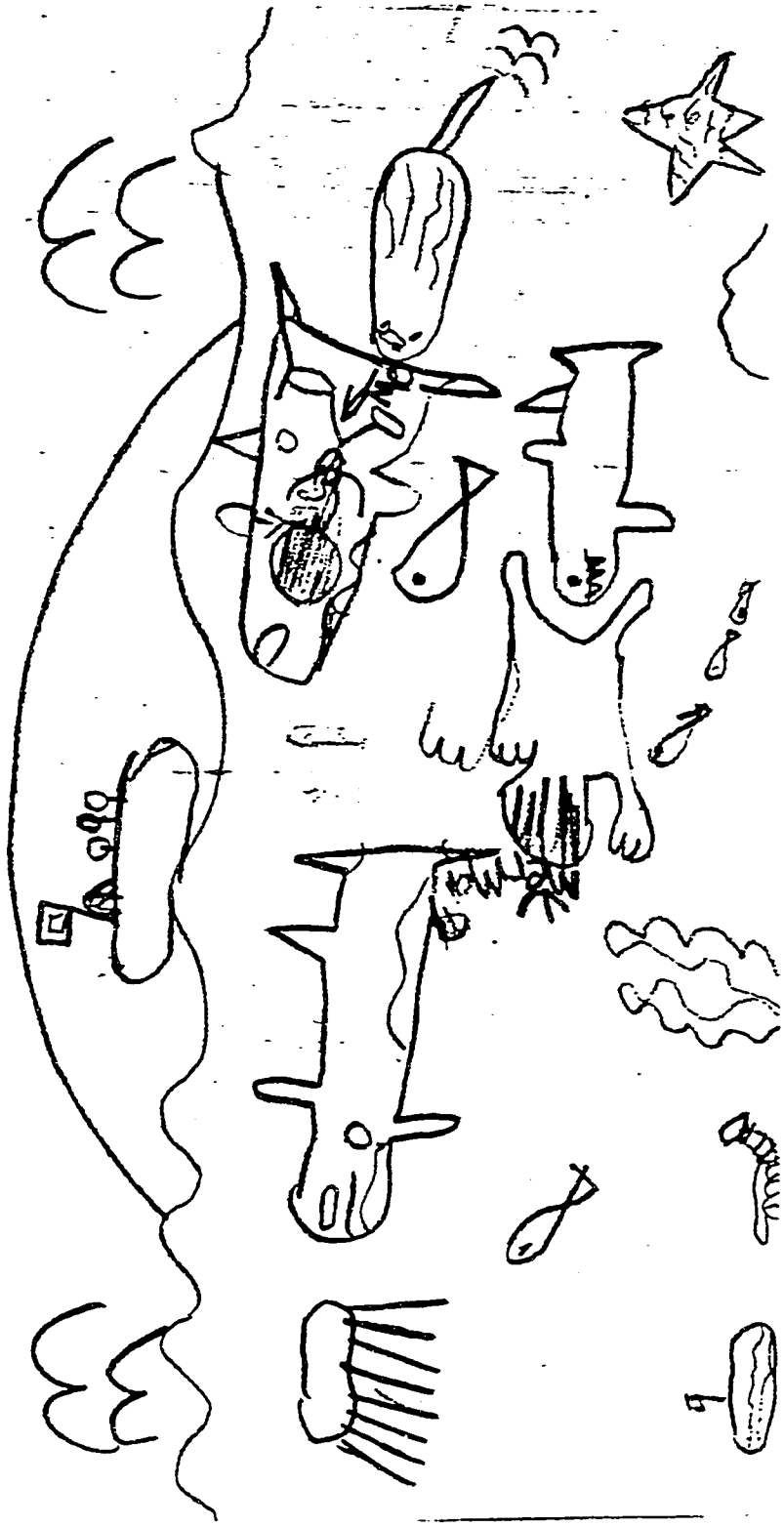
Drawing by ten-year old girl from inland California study area.



Drawing by eleven-year old boy from inland California study area.



Drawing by ten-year old girl from Denver, Colorado study area.



Drawing by ten-year old girl from Denver, Colorado study area.

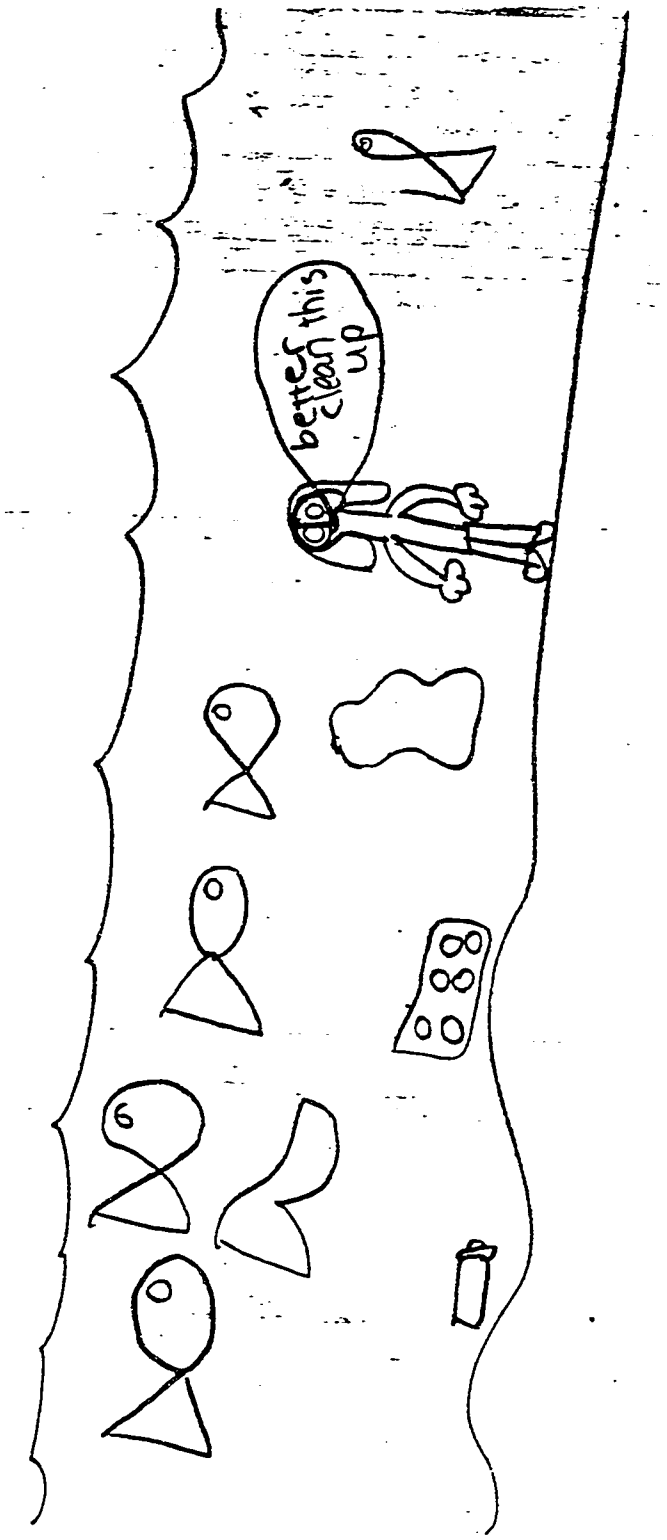
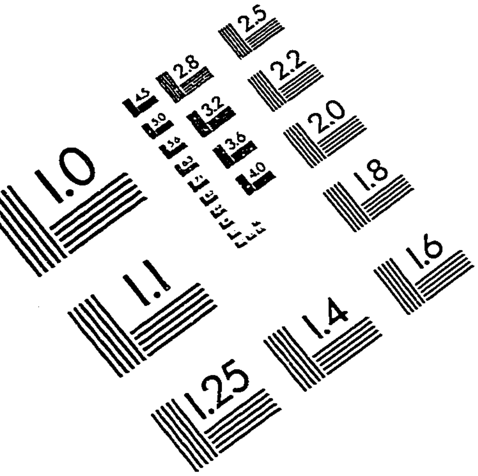
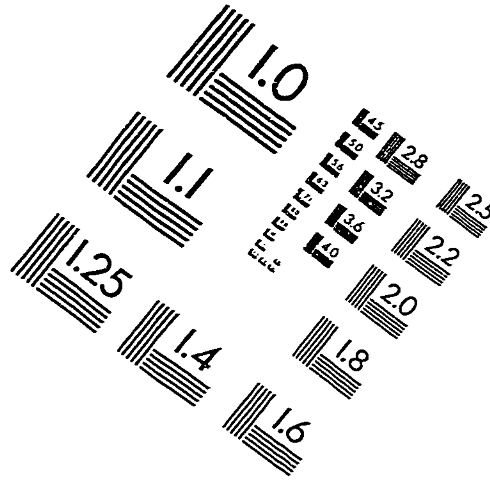
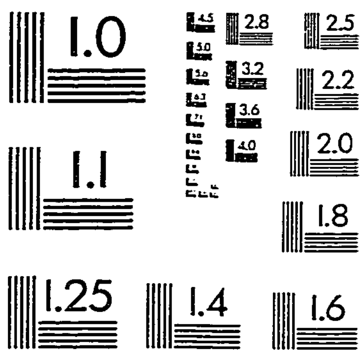


IMAGE EVALUATION TEST TARGET (QA-3)

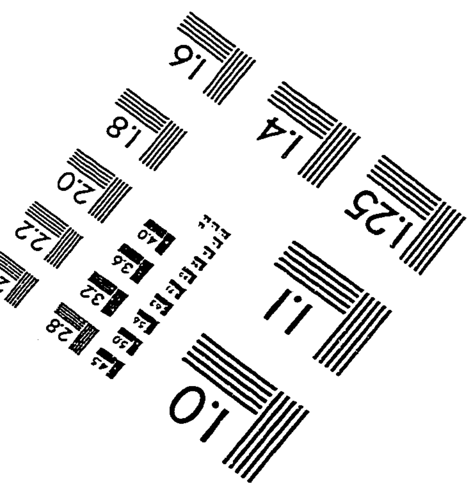


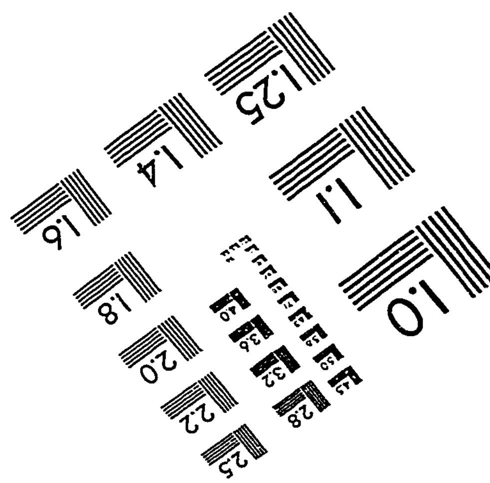




150mm

6″





APPLIED IMAGE, Inc
1653 East Main Street
Rochester, NY 14609 USA
Phone: 716/482-0300
Fax: 716/288-5989